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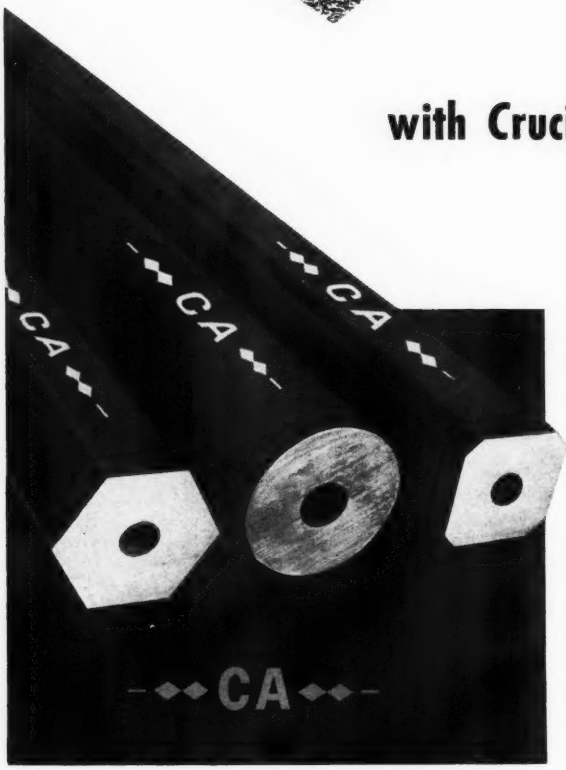

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Mining CONGRESS JOURNAL

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CONTENTS

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American Coal Company .... (2)
Ames Mining Company .... (2)
Anchor Coal Company .... (2)
Boone County Coal Company .... (2)
Brule Smokeless Coal Company
Buckeye Coal & Coke Co.
Carbon Fuel Company
Clear Creek Coal Company
Crozer Coal and Coke Company .... (4)
Eastern Gas & Fuel Associates
Elk Lick Coal Co.
Ethel Chilton Mines .... (2)
Gay Coal and Coke Company .... (2)
Gay Mining Company .... (2)
Gulf Mining Company
Guyan Eagle Coal Company
Hoylman Coal Company .... (2)
Island Creek Coal Company .... (2)
Imperial Smokeless Coal Company
Jacob's Fork Pocahontas Coal Company
Johnstown Coal & Coke Company
Kimberling Collieries Company
Lafayette Springs Coal Company
Lake Superior Coal Co.
F. M. A. Leach
Lorado Coal Mining Company
L & W Coal Company
Maust Coal & Coke Company
Mt. Hope Coal Company .... (3)
Nassau Coal Company .... (2)
New River Company .... (3)
Olga Coal Company
Pardee and Curtin Lumber Company
Pecks Run Coal Company
Peerless Coal & Coke Company .... (2)
Peters Creek Coal Company
Pocahontas Fuel Co.
Pond Creek Pocahontas Coal Company ...... (2)
Premier Pocahontas Collieries
Raine Lumber and Coal Company
Raleigh-Wyoming Mining Company
Red Jacket Coal Company
Ridgeview Coal Company
Royalty Smokeless Coal Company
Slab Fork Coal Co.
Sycamore Coal Company .... (2)
Tioga Coal Corporation
Truax-Traer Coal Company
United States Steel Company .... (3)
West Virginia Coal & Coke Corporation
Weyanoke Coal and Coke Company .... (2)
Winding Gulf Collieries

KENTUCKY

Bell & Zoller Coal & Mining Company ..... (2)
Begley & Conley Coal Co.
Big Jim Coal Company
Black Star Coal Corporation
Carrs Fork Coal Company
Cinderella Coal Corporation
Citation Coal Company
W. G. Duncan Coal Company, Inc. .... (2)
Eastern Coal Corporation
Fed's Creek Coal Co.
Field's Branch Coal Co.
Fourseam Coal Corporation
Harvey Coal Company .... (2)
Inland Steel Company
Jewell Ridge Coal Corporation .... (2)
Kentland Elkhorn Coal Company
Knott Coal Corporation
Liberty Coal Company
Liberty Elkhorn Coal Company .... (3)
Majestic Collieries Co.
Mary Gail Coal Company .... (2)
Smith Coal Company
West Kentucky Coal Company

TENNESSEE

Block Coal & Coke Company

CARDOX CORPORATION

ANNUAL *Roll Call*

PENNSYLVANIA
Barnes & Tucker Company
The Berwind-White Coal Mining Company
Cambria Clearfield Mining Company
Campbell Coal Company
Johnstown Coal & Coke Company..........(2)
Mathies Coal Company
Marco Coal Company
Moffitt Coal Company
Morrisdale Coal Mining Company
Ontario Coal Mining Company
Pittsburgh Coal Company..................(5)
Rochester & Pittsburgh Coal Co............(2)
Springfield Coal Corporation
Westmoreland Coal Company..............(2)

OHIO
Columbia Southern Chemical Corporation
Dindo Coal Company, Inc.
The Farm Bureau Cooperative Association Inc.
Gem Coal Company
Hanna Coal Company of Ohio..............(2)
Jefferson Coal Company
Lorain Coal & Dock Company..............(2)
Merrick Coal Co.
Powhatan Mining Company
Ten X Coal Co.
Warner Collieries Company................(2)

ILLINOIS
Bell & Zoller Coal & Mining Company.......(3)
Belle Valley Coal Company
Blue Bird Coal Company
Carmac Coal Company
Chicago, Wilmington & Franklin Coal Company
Deer Creek Coal Company
Eddy Coal Company
Elk Coal Company
Freeman Coal Mining Corporation
Mid-Continent Coal Corporation
Moffat Coal Company
Old Ben Coal Corporation................(3)
Peabody Coal Company....................(5)
Pschirrer & Sons Coal Company
Sahara Coal Company.....................(3)
Truax-Traer Coal Company
Union Colliery Company
Wilkins Coal Company

INDIANA
Enoco Collieries Company
Fairview Collieries Corporation
Ingle Coal Corporation
Pandora Coal Corporation
Princeton Mining Company
Snow Hill Coal Corporation................(2)

OKLAHOMA
Reliance Smokeless Coal Company

COLORADO
Arrowhead Coal Company..................(2)
Bear Coal Company
Black Diamond Fuel Company
Boulder Valley Coal Company
Chandler Coal Company
Champion Coal Co.
Clark Coal Company
Clayton Coal Company....................(2)
Colowyo Coal Company
Dry Creek Coal Company
Golden Quality Coal Co.
Imperial Coal Company...................(2)
Jenkins & Mathis Coal Company
Juanita Coal & Coke Company
Minerals Development....................(2)
William E. Russell Coal Company
Taylor Coal Company
Thompson Creek Coal & Coke Corp.
Tomahawk Coal Company
Vento Coal Co.

MONTANA
Brophy Coal Company
Johnson Coal Company
Mountain State Mining Company
Nies Brothers
Northern Coal Company
Roundup Mining Company
Western Coal Company

WYOMING
Colony Coal Co...........................(2)
Gunn & Quealy Coal Company
Ronocco Coal Company
Storm King Coal Company

UTAH
Browning Coal Mine
Hi-Heat Company
Lion Coal Company

ARKANSAS
Quality Excelsior Coal Company
Smokeless Coal Company

CANADA
Amalgamated Coals, Ltd.
Century Coal Ltd.........................(2)
Lethbridge Collieries, Ltd.
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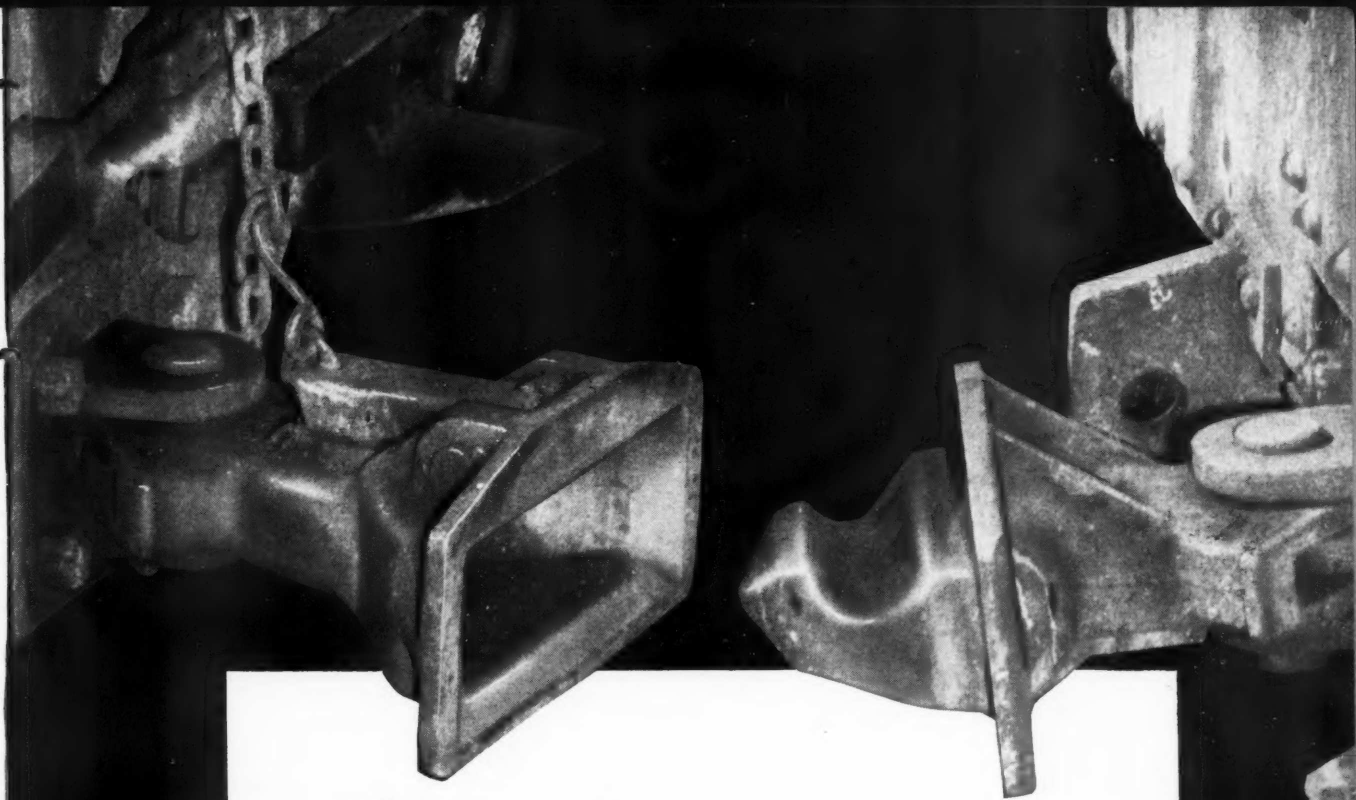

★ Mining ★
CONGRESS JOURNAL

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ROBERT W. VAN EVERA, Editor

Keeping the Wheels Turning

THE changing character of the manpower skills required to keep pace with ever-increasing applications of new and improved coal mining equipment were ably portrayed before the AMC Coal Division Conference last month by Jerry W. Woomer, consulting mining engineer. He said that the bituminous coal production rate has now reached 1900 tons per-man-year, and predicted that in 20 years the industry will achieve the rate of 4000 tons per-man-year, but that this can be done only through increased mechanization. Woomer further forecast that by 1975 the number of direct-labor production workers at the face will drop from the present figure of 100,000 to 38,000, while the maintenance force will have to be increased almost 100 percent, from 26,000 to 49,000, to service the additional machinery that will be required.

Maintenance is rapidly becoming a science in its own right. Some mining operations are already so busy trying to keep present equipment in operation that they have been unable to anticipate future emergencies and eliminate them in advance. At other properties preventive maintenance programs have been developed and put into effect, and inevitably all companies will give increasing attention to this practice. Emergency repair work will always be in the picture, however, and its extent will depend in part upon how good or bad the design of each machine and component may be.

Since the rate of manufacture of new equipment must steadily increase, it is important that performance be traced continually. The mechanic or machine operator is no longer able to give a valid appraisal of new equipment after a two-weeks' trial. Controlled on-the-job testing and good maintenance records are imperative if the complicated, highly specialized machines of the modern mine or quarry are to be accurately evaluated. Only with such records is the purchaser ably qualified to go back to the designer to have the machine modified.

Manufacturers' field representatives have a great responsibility and make a real contribution to equipment maintenance, by performing the unenviable function of liaison between the user and the manufacurer in run-of-the-mill troubles. They must funnel information both ways if breakdowns on the job are to be corrected at the drawing board.

Now how will the industry go about the task of training or recruiting double the present maintenance force, both to perform emergency repairs and to carry on preventive maintenance? Segments of metal mining and industrial minerals industries have an even greater job than the coal industry because in recent years mechanization has come faster in coal than in other minerals. Mining company shops are already straining for qualified personnel. Both practical and theoretical talents must be used, each to temper the normal excesses of the other.

The practical skill required in the majority of these additional men will be developed by training on the job, but this won't come about through exposure alone. Supervisors and personnel administrators will have to see that training is thorough, explicit, and expeditious. Carefully planned, well regulated programs are required. The investment in training will be greater than ever before, but the cost can be readily justified by the much greater investment in the equipment to be serviced and by the sizable savings in direct labor through its use.

Training in theory and the sciences will, no doubt, be left to our colleges. We have already heard a great deal about the problems confronting our educators in equipping their schools and attracting young men to higher education in all phases of mineral technology. From Woomer's figures it is apparent that these problems will multiply in the future.

"Git Thar Fustest With the Mostest"

THE military holdings of Federal lands are approximately 21.5 million acres, as of the latest published figures. There are requests pending from the Army, Navy, and Air Force for the withdrawal of several million more acres. Since most of the land desired by the military is in remote, unsettled areas, there results a natural conflict with the interests of prospectors and miners.

We have no desire to hamper in any way the building of the finest military air arm in the world, because in the present situation a second-best air force is wasted effort. Likewise, we have no desire to hinder the development of strong ground forces and a potent navy. But when military interests seem to conflict with the interests of civilians, particularly in a basic industry such as mining, which produces the very materials from which airplanes, tanks and other needed weapons are made—it is time for a study to determine just what course is best for our country.

The need for continued mineral development on the public lands is clearly recognized by the American Mining Congress in its Policy Declaration adopted at Las Vegas in October. Discussions at that meeting of the increasing demands of the military for additional acreages of public lands have resulted in the institution of an investigation of this matter by Congressional Committees.

The Western Governors' Mining Advisory Council, meeting recently at Sacramento, brought this problem clearly into focus and urged the Governors of the public land States to seek Federal legislation to curb unnecessary withdrawals of public lands by the military or other Government agencies.

We congratulate the House Interior and Insular Affairs Committee for its prompt action in starting its investigations and allotting time for hearings.

It is understandable that military men unfamiliar with mining activities erroneously look upon large unsettled tracts of land as being valueless to civilians. We must therefore impress the armed forces with the need to adhere to sound public land policies that will effectively encourage the discovery and development of the mineral resources in the public domain, and provide them with the sinews of defense which they constantly seek.

Surface view of the Bell Mine and Lime Plant

Drilling and Blasting at The Bell Mine

Longhole Techniques Lead to a Change of Mining Method at a Pennsylvania Limestone Operation

By H. A. CORRE
Mine Superintendent
The Warner Co.

THE physical characteristics of the limestone deposit of Central Pennsylvania permit the use of large stopes in mining operations, and efficient use of long blast hole drilling in the Bell Mine of the Lime Division of the Warner Co. located at Bellefonte, Pa. The mine is operating in the Lowville Limestone, locally known as the "Bellefonte Ledge." This ledge, although quite massive, has well defined bedding planes, with claylike material between the beds. It is 60 ft wide normal to the dip, but 5 ft to 6 ft of stone must be left to prevent contamination by a shaley ledge adjacent to the hanging wall. The ledge dips steeply from N 52° at the shaft collar to N 88° at the bottom of a 768-ft shaft.

The quality of the stone in the ledge is uniform, analyzing 98 percent $CaCO_3$. The physical characteristics are uniformly strong throughout the mine, no timber being required for support.

The mining operation of the Bell Mine extends 11,500 ft west from the main shaft, and 4000 ft east along the strike. The underground operations are reached by a three-compartment shaft in the country rock 90 ft below the footwall of the ledge. All other underground workings are in the merchantable stone.

Mine Development

Development work in the mine is done in the conventional manner, with main drift-raises, man-drifts, and undercuts following in a normal sequence. All drift development drilling is done with three-in. automatic percussion drifters, either post-mounted or jumbo-mounted, using one-in. hex steel with detachable steel bit.

Stoper drills are used in raise work, with ⅞-in. hex steel and the detachable bits. All holes are bottomed out at 1⅝-in. The average footage per bit is 95 ft, and bits are ground for reuse. Some tests have been made with tungsten carbide bits, but to date these bits have not proved to be economical, in comparison with the steel bits.

Man-raises are placed on the footwall on 355-ft centers along the strike in the 40-ft pillar between the stopes. Cross-cuts are placed at proper locations, depending upon mining system. Stopes in the Bell Mine are 315 ft long, measured along the strike; 250 ft above the undercut, measured along the dip, and 55 ft wide, normal to the dip. Approximately 380,000 tons of stone are recovered per stope, with no pillars removed. This size stope lends itself very well to longhole mining.

Equipment Used

All longhole drilling is done with post mounted Sullivan HS-15 air driven rotary drills. The drill is operated at 3300 rpm at 95-100 lb air pressure. The drill rod advance is controlled by gear reductions of 100, 200, 300 and 450 rpm per in. of advance. The 100 rpm gear is made on special order to meet the conditions in the Bell Mine. It has been our experience that the speed of drilling varies with the length of hole drilled. The first 75 ft can be drilled at the rate of 33 in. per minute, but it is

necessary to reduce this rate of advance as the length of the drill steel column increases. All drills used in vertical fan drilling pattern are equipped with protractors to measure the angles. Two-ft EX drill rods are used, and all rods are added in front of the machines. Pneumatic rod pullers are used to remove steel from the holes. Four-in. air lines supply air to the sublevels, with two-in. line to the machine. Two-in. water lines are carried to the machine, with pressure of 75 lb.

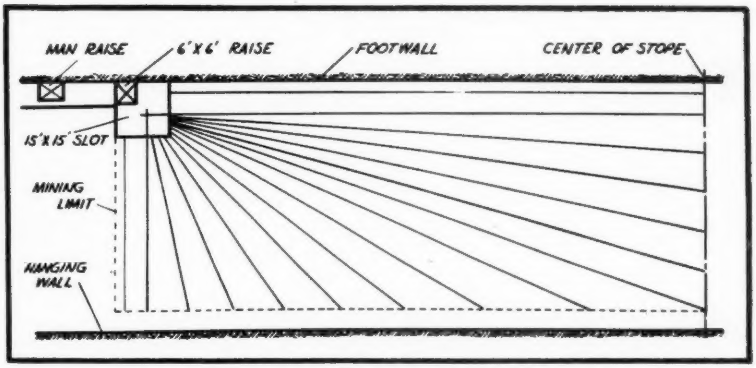


Fig. 2—Plan view showing horizontal fan drilling pattern

Change from Shrinkage To Sublevel System

During most of the life of the mine, the conventional shrinkage stoping method has been used. A slot eight ft to 10 ft high was cut from the footwall toward the hangingwall and, upon completion of the slot, roofing was done in a 19-ft stope along the strike toward the opposite end of the stope. Post-mounted drifter drills were used for this work. Upon reaching the opposite end of the stope the process was reversed, and the roof was raised another 8 ft to 10 ft and the stope traversed again. This continued until the stope had reached the desired height. In 1946 the air operated rotary drill was introduced, and long blast hole drilling was started. As is often the case in new methods, longhole drilling occasioned many unexpected experiences. These brought about variations in the shrinkage system of stope mining and resulted in the adoption of the sublevel system.

During the first year of longhole drilling the old slot system was used. Sufficient room was shot out of each side of the stope at the intersection of the pillar line and the foot wall to set up the rotary drill, with a crew working on each end and mining half of the stope. From this opening a slot 10 ft high and 15 ft wide was then drilled and blasted toward the hanging wall. After this operation the drill was set up and 150-ft holes were drilled toward the center of the stope, each hole requiring a new set-up of the drill. The holes were drilled parallel to each other on eight to 10-ft centers, with 10-ft burden. This practice proved to be costly and slow, since drill location had to be accurate and considerable hand mucking was required. Difficulty was encountered in keeping the holes properly aligned.

Fan Pattern

After trial and error, the present method was adopted, starting at the undercut level and putting up a six-ft by six-ft slot raise on each end of the stope. These raises are on the footwall inside the stope limit, and connect with the crosscuts of the man raise. This permits entrance to the stope from the man raise, since the roof of the stope is below the open cross cut. This inside stope raise can be advanced one crosscut at a time as the roof line approaches the crosscut. Figure 1 shows vertical elevation of shrinkage stope development work. This raise also provides the starting point of the second phase of the operation, the slot. After the stope shot has been blasted, the miners install a platform within this inside raise, at the elevation of the new burden. The six-ft by six-ft raise is then enlarged toward the hanging wall and the center of the stope into a 15-ft x 15-ft opening called a slot. The long blast holes are drilled from this slot. The longhole drilling is in a horizontal fan pattern as follows: One hole is drilled parallel to the footwall 140 ft to the center of the stope with one set-up of a vertical bar two ft off the footwall. The bar is then re-set approximately six ft toward the hanging wall from the first hole. The second hole is drilled 140 ft deep parallel to the first one. From this second setting of the vertical bar the fan drilling pattern is started and continues until a 90° fan is completed. The holes drilled from the second setting of the bar are spaced eight ft to 10 ft apart at the end of the holes. Six holes, 140 ft deep, are drilled across the width of the vein. Six additional holes are drilled on the hanging wall, decreasing in length until the 90° fan pattern is completed. The final hole is 40 ft in length. The third setting of the bar is made to permit the drilling of the two holes 40 ft deep toward the hanging wall and parallel to the pillar line. Figure 2 is a plan view of the horizontal fan drill pattern. The total footage drilled for the average shot is 2350 ft.

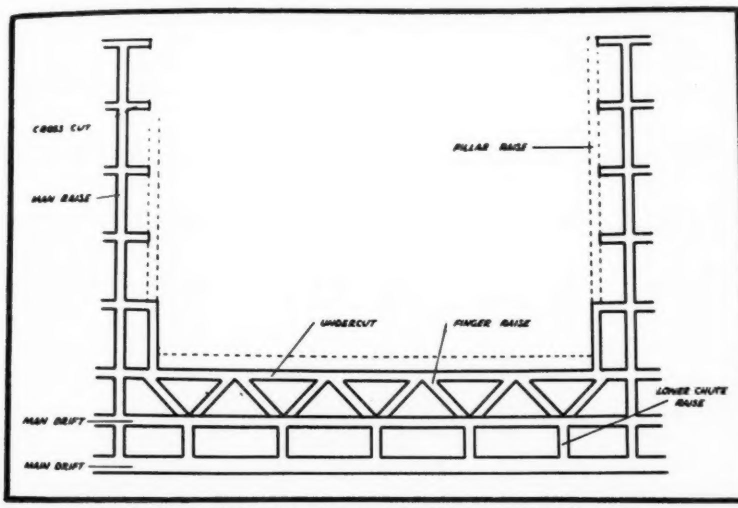


Fig. 1—Vertical elevation showing development of shrinkage stope

Drilling Performance

In this system 18 crew-days are required to drill and blast each round after the slot work has been completed. Five crew days are required to prepare the slot.

Much of this time is spent in building platforms, handling tools, and hand mucking. The speed of drilling is reduced because of the large number of long holes. The three set-ups required are time consuming, and affect the over-all efficiency of the operation.

A two-man crew averages 150 ft of drilling per day. A complete round on each half of the stope when shot will produce about 6300 tons of stone.

Blasting Shrinkage Stopes

After the drilling is completed, the holes are loaded with 1¼-in. x 24-in. 60 percent semi-gelatin dynamite, that has been packed to specifications to permit loading of the long holes. The dynamite is pushed to the end of the holes with six-ft aluminum-tipped wooden sectional loading poles with patented couplings that prevent disjointing of the loading poles in the holes. Each hole is primed with two detonators to assure complete detonation, and detonators are placed 50 ft and 100 ft from the collar of the holes. Zero delay detonators are used in all holes except those along the footwall and the pillar line. These holes are primed with No. one delays. This allows the footwall and the pillar line to be cleaned, thus permitting sufficient space to start the next round of holes. The burden on each shot is eight ft.

This type of mining, although much safer, proved to have its disadvantages. Instead of correcting the mistakes of the old roofing method, it compounded them. The alignment of holes was a problem at first but, by more careful supervision and training, this was overcome. The greatest headache was blasting. At first one detonator was used, but it was soon learned that on holes over 75 ft long continued detonation is not assured, because of pressure built up within the holes by the exploding dynamite. Until recently, Primacord in sizes small enough to fit in the holes was not available. Fragmentation left a lot to be desired, even though reduced burden and smaller spacing was used. With the holes being drilled along the strike of the ledge there is a tendency for long large pieces of stone to break from the bottom of the shot requiring expensive secondary blasting. It was also noted that with the shrinkage method any mistake made in drilling or blasting was not discovered until complete withdrawal was made, since at least 50 percent of the stone shot down had to remain in the stope, and any mistakes were covered up by succeeding shots.

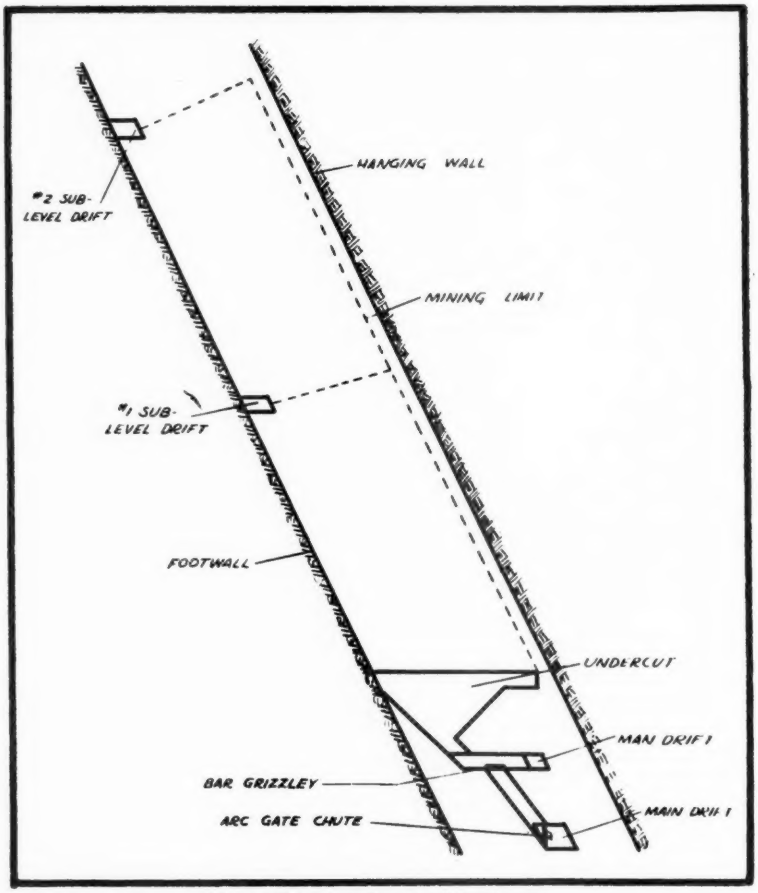


Fig. 4—Side elevation of sub-level stope

Disappointing as were the results, it was agreed that long hole mining had merit, so in 1947 studies were made of the possibility of the sub-level system of mining. First studies and experiments indicated that the system could be adopted for use in the Bell Mine.

Sublevel System

The first attempt in sublevel mining was made on a sublevel interval of 60 ft to determine cost, drilling technique, and other factors which could not be foreseen. After some experience was obtained, sublevel intervals of 90 ft, 115 ft and 125 ft were attempted successfully. The 125-ft interval has become standard.

The sublevel system as adopted in the Bell Mine is in two stages: (1) Sublevel development; (2) Long hole drilling. The primary development of main drift, raises, man drift, and undercut is the same as for the shrinkage stope system. In the sub-level system a six-ft x six-ft raise is put up along the footwall inside the stope limit and connected with

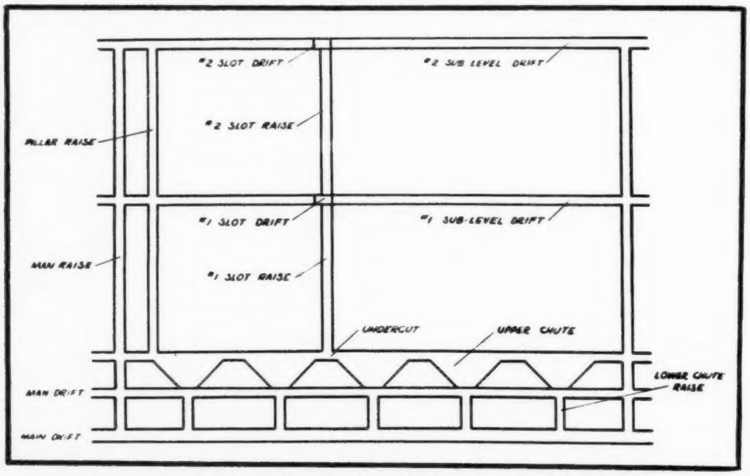


Fig. 3—Vertical elevation showing development of sub-level stope

the man raise by a crosscut. This is used as a transfer raise for the muck from the subdrift. At points 125 and 250 ft above the undercut, sublevel drifts eight ft x 10 ft in cross section are driven on the footwall 350 ft along the strike toward the man-raise on the opposite end of the stope. These drifts intersect an off-center raise that is put up the full height of the stope from the undercut. The raise is placed off center purposely, in order that two drawpoints can be utilized for immediate stone withdrawal, and to provide two rotary drill locations in the sublevel. From this raise a cross or slot drift eight ft x 12 ft is driven toward the hanging wall to the country rock. All drifts are drilled using post-mounted three-in. percussion drill. Broken muck is moved by 25 hp two-drum scraper hoists with 48-in. scrapers. Figure 3 shows a vertical elevation of the sub-level stope. Figure 4 shows side elevation of the sublevel stope in relation to grizzly and haulage levels.

After the subdrift is driven to the opposite end of the stope the slot is opened from the raise in the center of the stope toward the hanging wall. An HS-15 rotary drill is mounted on a universal bar mounting to drill out the slot. Four holes are drilled downward parallel to the dip on four-ft centers and a burden of four ft to 4½ ft. The two outside holes are angled slightly from the center holes and provide a cone effect to prevent the broken stone from jamming in the slot area. Upon completion of the slot two rotary drills can be put into operation on each sublevel. Figure 5 shows the slot drilling pattern. Millisecond delays are used to blast the slot, with 1¼-in. x 24-in. dynamite and Primacord.

The long hole drilling is accomplished by mounting an HS-15 drill on vertical column bar in the subdrift and drilling holes in a vertical fan pattern toward the hanging wall. The hole spacings are eight ft at right angles to each other at the bottom of the holes, with nine-ft to 10-ft burden. Because the roof of the stope breaks to approximately right angles to the dip of the ledge, two holes are drilled upward above the horizontal to establish a roof line by blasting, rather than permitting the caving of large blocks of stone that would cause trouble in the finger raises. Figure 6 shows a typical drill pattern for the 125-ft sublevel, with length and angles of holes. Each crew is provided with a copy of the pattern, and is able to complete the drilling without direct supervision.

The sublevel system of mining has many advantages, including: (1) Broken stone inventory is kept to a minimum; (2) Stone breakage has been improved; (3) Errors in drilling and blasting can be observed and

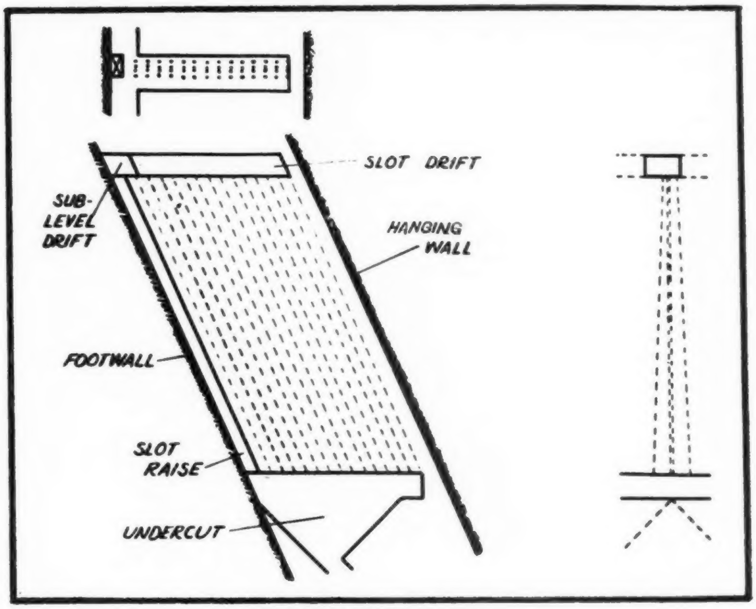


Fig. 5—Slot drilling pattern

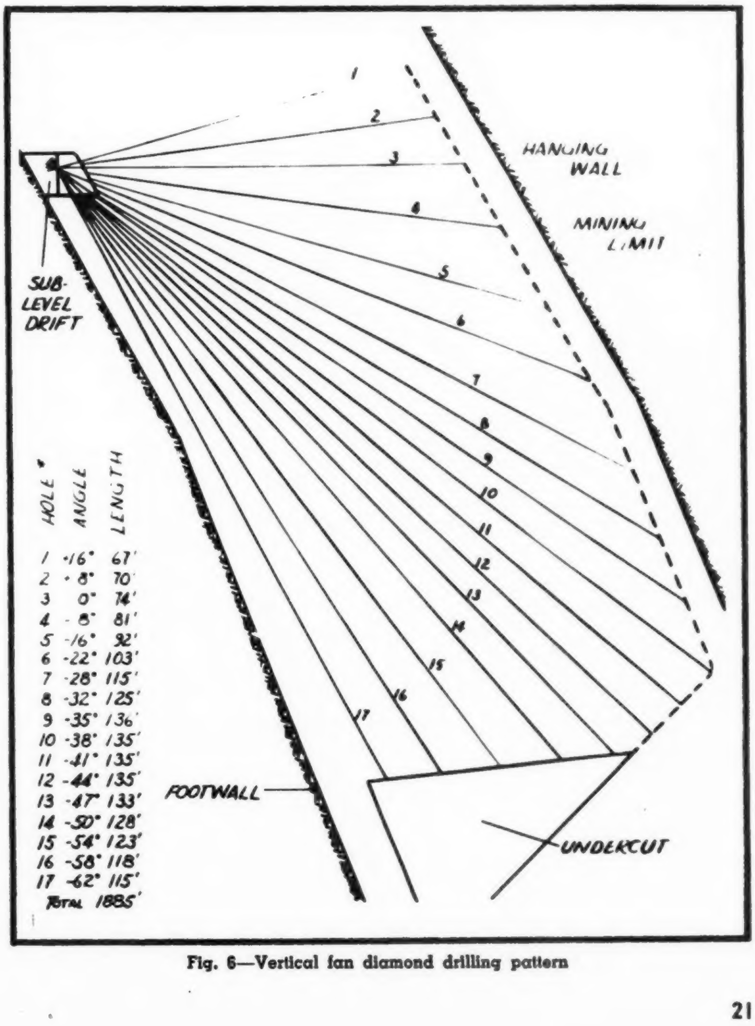


Fig. 6—Vertical fan diamond drilling pattern

corrected; (4) A safer type of mining; (5) Increase in tonnage shot down without multiple shifting.

The greatest disadvantage of the system is the cost of the development stage of the stoping operation, with little or no tonnage being available.

Drilling Procedure

The two-man crew assigned to each drill location does all drilling; handling of dynamite into the stopes from the haulage drifts; loading of the holes for blasting; making all electrical blasting connections required in the stope; setting up and tearing down of drilling equipment, and miscellaneous work incidental to the operation.

A crew of two men will drill out a complete round in the 125-ft sublevel in 12 crew-days. The footage drilled per round is approximately 1900 ft and when shot will produce about 5700 tons of stone. Following is a breakdown of items for the various phases of the operation:

Operation	Percent of Time Required
Drilling	82.
Loading and Handling of Dynamite	9.25
Mucking, Set-ups, Tear Down	7.25
Miscellaneous delays, including equipment	1.50

Ninety-five ft per man shift, or 190 ft per crew-day is obtained with approximately 3.0 tons of stone broken per ft of hole drilled, at a direct labor cost of .07c per ton. Total stope mining cost, including stope development, is .256c per ton.

The men employed in long hole drilling are paid on an hourly basis. Travel and lunch periods are included in the normal eight-hr day. It is felt that this type of mining lends itself to an incentive pay system. There is no doubt that the proper system would reduce the outages such as shooting and set-up time, as well as increase the footage drilled per day. An incentive system has been discussed but, due to conditions, it has not developed beyond that stage.

Diamond Bit Performance

A study of rotary drilling practices must include the study and development of diamond bits to fit the drilling conditions encountered. This study has been slow and tedious. Random purchase of diamond bits proved to be extremely costly in the early days of long blast hole drilling in the Bell Mine. Tests were conducted to compile data for making analysis of bit performance. Information recorded during these tests included type of bit, carats per bit, diamonds per carat, salvage per bit,

Rubber-tired, two-drill Jumbo at work

carats used per bit, footage drilled, bit cost, cost per foot, drilled, and cost per ton.

Analysis of bit performance indicated that the pilot type non-coring bit showed greatest footage drilled, highest diamond salvage per bit, and lowest cost per foot drilled. Also, if

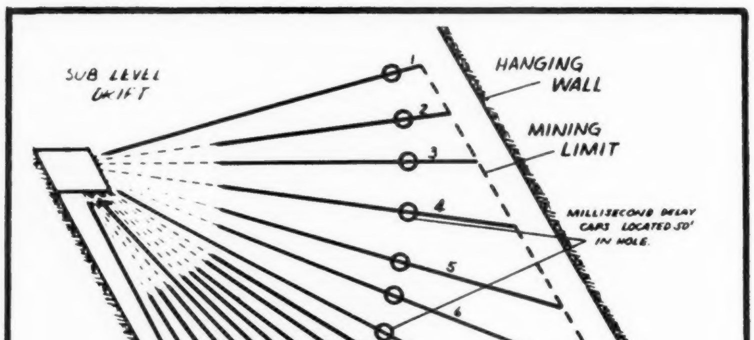


Fig. 7—Vertical fan shot loading diagram

TABLE I

Year	Ft Per Bit	Carats Used Per Ft Drilled	Salvage	Cost Per Ft Drilled	Cost Per Ton
1951	3630	.00089	67.7	0.0122	.0065
1952	4930	.00085	68.1	0.0111	.0041
1953	4300	.00084	69.6	0.0110	.0032
1954	5590	.00069	67.7	0.0076	.0022

a bit were to be developed for best performance, it would be necessary to rely on one manufacturer for bit replacements. The Trueco Bit was adopted, and, by close cooperation with the Wheel Trueing Co. on suggested changes, bits to specification are furnished and have given good performance.

The bit best suited for use in the Bell Mine is as follows: 13 to 14 carats per bit, 15 to 20 diamonds per carat, with special O. D. Kickers, a $\frac{5}{16}$-in. water hole, and a matrix adapted to drilling conditions. These specifications have been developed over a period of years, and Table I shows performance during the past four years.

One bit drilled 27,560 ft of hole and was taken out of service to be studied. This performance is an exception rather than the rule, although footages of 10,000 ft to 12,000 ft per bit are not uncommon. The main cause of bit failure has been insufficient water at the face of the bit. Water pressure must be maintained to keep the face of the bit clean at all times, with a sufficient volume to keep the drill cuttings washed out of the hole; otherwise a plastic mass would form in the hole. Because of the claylike seams between some of the beds to be drilled, bits are sometimes plugged and no water can be forced through the drill rods and bits and, due to the speed of rotation of the drill, a bit will be damaged very quickly.

Diamonds becoming dislodged from the matrix have caused bit damage and resulted in low footage, hence a study of a suitable matrix was important. Diamond bits are taken out of service when there is evidence that the drilling speed of the machine has been reduced. The foreman in charge determines when a bit is not performing in the proper manner. Experience indicates that diamond drill bits left in service too long result in low diamond salvage and increased bit cost per ft of hole drilled. In addition, the drilling performance of the crew is reduced and, since the labor cost far exceeds the bit cost, bit replacement is advisable.

Bit performance varies among drilling crews. Although much has been accomplished in improving drilling practices of individuals, much remains to be done. Because of a bidding system in practice under the Union contract, a turnover in manpower presents a constant training problem. An investigation is being made of oriented bits, but sufficient data is not available for a good analysis.

Improvement of bit performance continues to be of major importance in the longhole drilling program.

Blasting—Sublevel System

Each round is blasted upon completion of the drilling cycle. Should any errors in drilling or blasting occur,

A typical drill set-up for longhole drilling in sublevel, showing protractor and rod puller

the proper corrective measures are taken to prevent any cumulative effect that may be built up, and to eliminate unnecessary drilling.

Blasting practices at the Bell Mine are under constant study. It was learned very early in the longhole system of mining that it was easier to drill the holes than it was to load and blast them. The 1½-in. x 24-in. 60% semi-gelatin is used in loading the holes. The loading is staggered, in that the amount of dynamite in each hole is predetermined to give the desired result. Forty-grain plastic covered primacord is used in all holes. When blasted instantaneously, the primacord from Holes No. 3 to 16 is connected to a trunk line and detonated by one "0" delay. One No. 1 delay detonator is used to fire the remainder of the round. This method of blasting has proved successful but when future plans of the Bell Mine required mining operations close to a residential area, vibration tests were made to determine whether present practices would cause damage or complaints, and to determine whether improvements could be made in the blasting technique. Several tests were made and recorded on the use of millisecond or short-period delays. The tests were made on the surface over the same stope, with the number of holes, burden, and loading kept as nearly constant as possible, with changes made in the method of detonating the different rounds.

It will be noted that vibration has been decreased, and fragmentation has been increased. As a result of these tests, millisecond blasting has been adopted, with tests to continue periodically. Figure 7 shows loading chart indicating location of detonators. The 60-ft lead wire of the detonator is plastic covered and on spools to permit ease of loading. With this method of blasting, 5.45 tons of limestone is broken per lb of dynamite.

All blasting is done from a main blasting switch located on the surface. A system of relays is used to energize individual switches located at the man raise. Each working place is equipped with separate shooting circuits which can be disconnected at the switch when not in use. Disconnecting devices are used at the sublevels. Lead wires are not connected to the switches until all men are out of the blasting area.

Credit for much of the success of the blasting operations must be given to representatives of the powder companies for their advice and assistance, and to the technical men of the powder companies for making changes in type and design of the dynamite for use in the long drill hole.

Top Management Support

The adoption of high sublevel intervals in the stope mining phase of operation of the Bell Mine has brought about a change in plans for handling of stone in the future. Plans for a new level now in the preliminary stages of development include the use of high production loading equipment, large capacity cars, and a crusher of sufficient size to handle the stone the equipment will be capable of loading.

With continuous mining, ventilation at Enoco was changed from pressure to exhaust and efforts were extended to improve methane detection procedure

Ventilation and Methane Testing Procedure at Enoco Mine

Continuous Mining in Highly Gaseous Areas Poses Problem of How to Satisfactorily Handle Ventilation at the Face. Here is One Company's Answer

By JOHN A. STACHURA

General Superintendent
Enoco Collieries, Inc.

THE Enoco Mine of Enoco Collieries, Inc., is located near Vincennes, Ind. Coal is produced from the Indiana No. 5 seam, which ranges from 4½ to 8 ft in thickness, with an over-all average of six ft. Overburden runs about 425 ft. Daily production is 3500 tons with four units operating on the day shift and two units on the second shift.

The original fan installation was set up to ventilate the mine with forced air, until recently used almost exclusively in Indiana. With the installation of continuous mining machines and the extracting of pillars being practiced, however, the company changed its ventilation to an exhaust system in July 1953.

Now the mine is ventilated by a Jeffrey 8H 72-in. Aerodyne fan, driven by a 150-hp Crocker Wheeler motor, and operated at 1120 rpm. The fan produces 165,000 cfm of air at a water gage of five in.

Approximately 800,000 cu ft of methane is liberated every 24 hrs. The East side of the mine, with three operating units, liberates about 350,000 cu ft every day while the West side, with one operating unit, liberates about 450,000 cu ft.

Ventilation in Entry Work

Indiana State law requires that openings, or break-throughs, be made at intervals not exceeding 60 ft. Although this is a handicap at times, it does simplify the ventilation of working faces.

In main entries permanent stoppings are constructed of 8 by 8 by 16-in. solid concrete blocks. In room panels the temporary brattices are of wood construction.

In entry development certain working territories are advanced with no problem of gas at the working faces. But, in other areas extreme care must be exercised as gas begins to accumulate when the working faces advance a few feet beyond the last cross cut. In these areas added precaution must be taken when advancing the working faces. Because of sparks from the many boulders that are encountered in all areas, care must be exercised to prevent any accumulation at any place of an explosive mixture of gas.

Ventilation problems encountered on conventional units, where cutting, drilling, and blasting with compressed air make up the preparation cycle, offer little or no difficulty. The face areas are easily kept well ventilated and free from accumulations of methane.

The usual practice of keeping doors in good working condition, closing all break-throughs except the one nearest the working face, and using line brattice where needed, keeps all the working faces clear with little effort. This situation holds true in all areas at the Enoco mine producing coal with conventional equipment.

Ventilating Continuous Mining Sections

With continuous mining, the company found that in areas that do not produce much methane ventilation can be handled much the same way, with little or no curtain. However, in areas that produce large quantities of gas, the problem of ventilation becomes much more difficult with continuous mining.

To carry sufficient air to the face of each place where a continuous mining machine is operating is difficult. It requires closer supervision, more accurate brattice work, and frequent examinations.

Figure 1 illustrates the procedure followed at Enoco to get the maximum volume and velocity of air over a machine with a minimum of interruption to the air current.

The intake entry is driven 18 to 20 ft wide to permit sufficient area for good ventilation. A door, 10 ft wide, is installed in the intake entry far enough out by the last open break-through to permit the continuous mining machine, loading machine, and the shuttle car, to work at the face with the door closed. Air passes through the opening to the right of the door and is directed to the working face by a line brattice.

Break-throughs are all turned from the intake entry and continued across to hole into the remaining three entries. Doors are also installed in entries No. 2 and No. 3, and another door is installed between No. 1 and No. 2 entry just out by the last open break-through. This permits working in the face area without disturbing the line brattice. It has been necessary to maintain a minimum of 10,000 cfm of air sweeping around

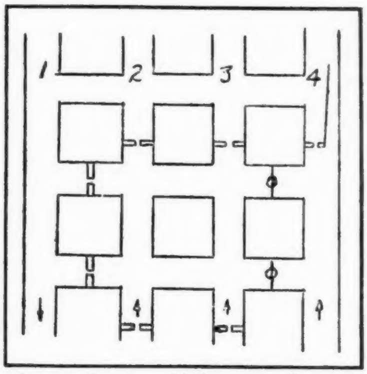


Fig. 1—Face ventilating procedure at Enoco

the end of the canvas to keep the faces clear, and permit the advance of the machine from 8 to 12 ft into solid coal beyond the last point of advance. Curtains are hung alternately on the left and right side of the entry in which the continuous mining machine is working. This allows the curtain to be hung on the right side of the room if the machine is working on the left lift and on the left side if it is working on the right lift, permitting air to sweep the entry faces at all times.

When the continuous mining machine penetrates the coal face more than six or eight ft on the first lift, it is difficult to hang curtain along the newly exposed rib because of the restricted area. To simplify this work, a plastic curtain mounted on slides has been placed on the side of the machine. This automatically extends the line curtain as the working face advances. The curtain has been well received by the machine operators, and as a result is used at all times.

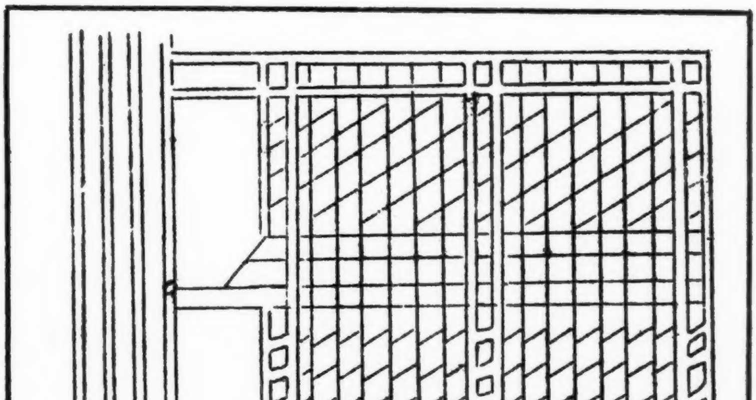


Fig. 2—A system of bleeders was developed to ventilate mined out areas

Room and Pillar Work

In room panels an entirely new method of ventilation had to be worked out. With full seam mining, entries had to be developed to provide bleeders around the gob areas. Figure 2 shows the entries being developed with rooms No. 1 and No. 2, No. 9 and No. 10, and No. 17 and No. 18 being developed as the entries are advanced to provide bleeder entries on both sides of the room panel. The bleeders are connected to the return entry. An overcast then permits pillar recovery with two machines, each on a separate split. During the development of the room panel, three entries are on the intake side of the brattice line and one of the return.

When development is completed, and room and pillar work begun, the bleeder entries then become return airways and the four entries become intake airways, thereby eliminating all doors.

Gas Testing Procedure

Prior to July 1953 it was a practice in all Indiana mines that examinations for gas were made only by mine officials.

Following a thorough study, and with the help of the Safety Division of the United Mine Workers of America, a program was set up for extending the use of safety lamp to all persons operating mining equipment. Numerous instruction classes were conducted to acquaint the men with the safety lamp and it's proper use. Enoco was the first mine to adopt the practice in the State of Indiana.

This has greatly increased the number of examinations made for gas in each working place during each operating shift.

To provide the operator of a continuous mining machine with a simple method for testing the air at the working face, a copper tubing was installed on the top and lower section of the cutting head of the machine and extended back to the operator's controls. Aspirator bulbs were placed on the ends of the tubing. To check the air, the operator draws the air through the aspirator bulbs into his safety lamp. This provides a simple test that can be made frequently. If he detects methane on the lamp, he stops and clears the face. He then advances again or trams back, resets, extends line curtain and begins a new lift.

Maximum penetration that can be made without tramming back, resetting, and advancing line curtain varies from eight to 25 ft.

A number of tests have been made on a W8 Methane Indicator to check the composition of the mixture coming through the tube against the actual mixture at the face. In all

(Continued on page 72)

Control of Cyclones and Cyclone Systems

Research on the Mesabi Range Where Cyclones Are Used to Concentrate Lean Ores and Taconite Has Developed a Wealth of Valuable Data

By EARL C. HERKENHOFF
Formerly Pickands Mather & Co.*

THE variables in cyclone operation which permit the operator to control the separation made by a cyclone with a given diameter are as follows:

(1) Feed dilution or pulp density
(2) Diameter of apex, or underflow opening
(3) Diameter of vortex finder or overflow opening
(4) Included angle of the conical section
(5) Feed pressure
(6) Feed nozzle area
(7) Height of cylindrical section
(8) Back pressure on or throttling of the overflow conduit.

Generally, control of the feed dilution is most commonly used to control the separation. Changes in diameter of the apex and vortex openings are the next most effective control points but in many cases require shutting down to make such changes. However, where apex diameters are controlled by inflatable rubber valves, this aperture may be quickly adjusted.

The use of dual vortex finders, one inside the other, with separate overflow conduits, the discharge from the outer vortex finder being controlled by a valve, achieves a substantial control of the separation without shutting down to change cyclone apertures. A cyclone so constructed can be used as a three product cyclone.

In general, with all other conditions constant, a decrease or increase in feed dilution will be reflected mostly in a decrease or increase, respectively, in overflow density. To a lesser extent, the underflow density will be affected in a similar way.

If the apex area is reduced, the underflow density and overflow density both will increase.

If the vortex finder or overflow diameter is reduced, the overflow density will decrease and the underflow density and discharge velocity will increase. The feed capacity will decrease.

If the included angle of the conical section is increased, that is, if the cone height is shortened, there is reduction in feed capacity and the overflow density increases. There is less tendency for the apex flow to choke off.

An increase in height of cylindrical section tends to reduce the feed capacity and decreases the quantity and density of the overflow product.

A decrease in feed pressure reduces the feed capacity and underflow density and increases the overflow density. Stated another way, more dilution water is required to maintain a certain overflow density if the feed pressure is reduced.

Feed nozzle area affects the capacity and if it is increased while holding the feed pressure constant, both the underflow and overflow densities will increase, and the overflow volume will increase sharply.

The length of the vortex finder inside the cyclone may be varied considerably but usually will not begin to affect the separation to any marked degree until it is below the junction of the conical and cylindrical sections.

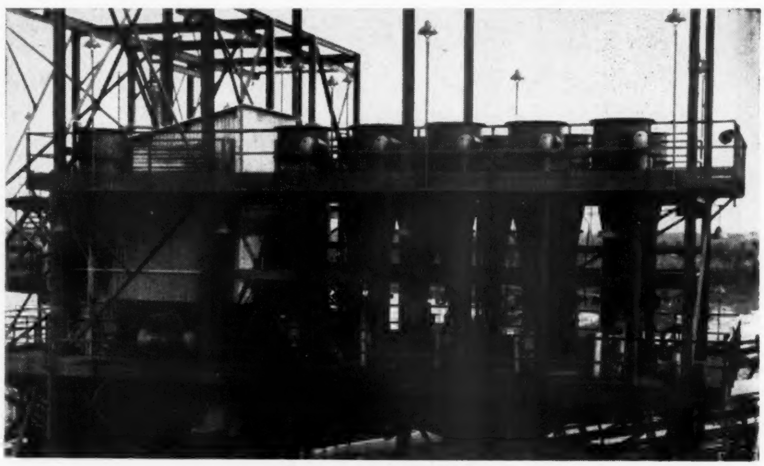
Back pressure applied to the overflow conduit will reduce the cyclone capacity and decrease the underflow density.

Control Systems

In the Erie Preliminary Taconite Plant at Aurora, Minn., where 80 long tons of taconite per hour are treated, the ball mill grinding circuit is closed by seven 14-in. cyclones, all with fixed apertures, operating from a common six-in. header. Usually, five cyclones are sufficient to handle the load, but because of variations inherent in the mining method and mineralogical composition of the ore, sometimes as few as three cyclones and as many as six are required. The operators are instructed to maintain the overflow density at a predetermined point by varying the dilution water into the feed pump. Also, they are instructed to maintain the feed pressure to the cyclone nozzles between 17 to 22 psi, by "putting on" or "taking off" a cyclone by means of air-operated pinch valves. Experimentation is under way to make this system entirely automatic by (1) putting a variable speed drive on the feed pump and maintaining a constant pump sump level by varying the pump speed (2) continuously measuring, recording and controlling the cyclone overflow density by regulating the quantity of dilution water to the feed pump, and (3) controlling the number of cyclones in operation to hold the header feed pressure at a constant level.

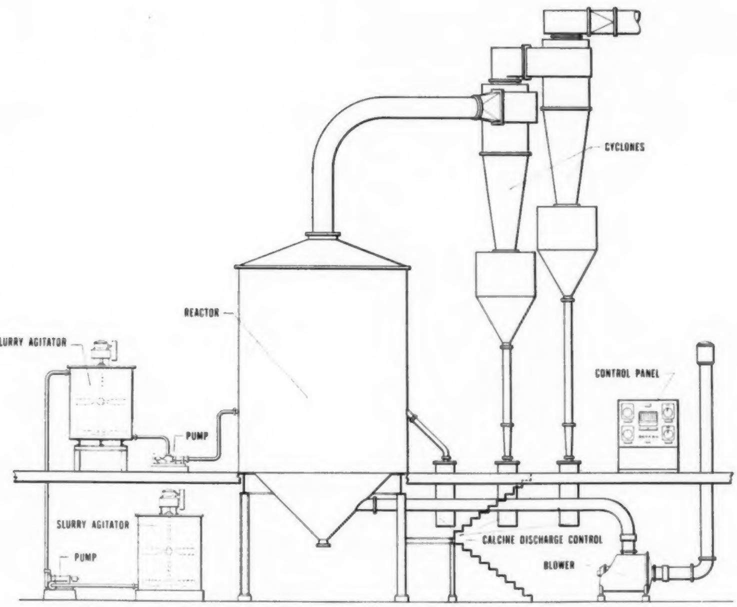
Several Units with One Header

When operating a number of cyclones from a common header, it is important to maintain the apex dimensions the same for all cyclones. That



A battery of cyclones

* The author is now Chief Metallurgist with the Utah Construction Co.



Diagrammatic flowsheet shows cyclone application in a uranium mill

is, if standby units are provided, they should be alternately run as operating units in order to balance out wear.

An Eastern magnetite concentrator installed a unique control for regulating a classification split made by a cyclone on magnetite concentrates, based on the original control system devised by Weaver and Wright of American Cyanamid Co. A single, 15-in. cyclone equipped with an air-inflatable apex valve is fed by a pump which delivers a feed of more or less constant volume but variable density to the cyclone. The cyclone overflow is discharged as a submerged flow into a receiving box; this is important in order to maintain a strong vacuum in the cyclone. The apex or underflow discharge is by gravity and falls free.

A vacuum probe inserted into the vortex finder through the overflow conduit senses the vacuum in the cyclone. As the underflow quantity increases, the vacuum inside the cyclone cannot be satisfied through the restricted air core flowing up through the apex and it in turn increases. The vacuum controller then calls for release of pressure to the inflated apex valve which opens and reduces the underflow density to put the system back in balance. With this method, the underflow density can be maintained at a predetermined point and, as a result, the overflow product also is regulated.

An adapation of this same scheme is used to control the crude ore feed rate to the grinding circuit in a new Canadian magnetite concentrator. In this case, the vacuum controller regulates the speed of the rod mill feed conveyor and does not adjust the apex aperture.

Density Controls

At the Crystal Silica Co. plant at Oceanside, Calif., where four Krebs EE10-9 cyclones treat a glass sand, a method for maintaining a high density underflow or apex product has been installed by placing two cylindrical receptacles, one inside the other, under the apex discharge. When the underflow is thick and roping, it falls vertically into the inner receptacle and is passed to further treatment steps. If the underflow is too dilute, it discharges in a typical whirling, conical spray and falls laterally into the outer receptacle, which returns the product to the feed pump where it is recirculated until the density of the underflow again reaches the desired roping point and the material can leave the circuit.

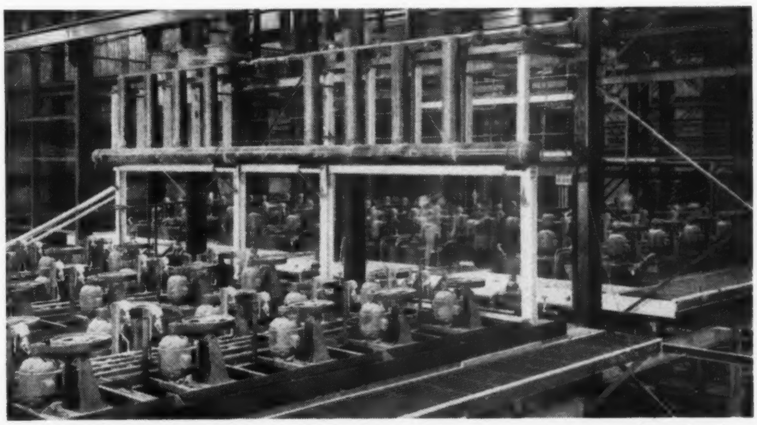
F. T. Weems in an AIME paper entitled, "Metallurigcal Applications of the Dorrclone" shows a method devised by the Dutch State Mines for maintaining the feed pump sump level at a predetermined point which consists of discharging the cyclone overflow into a small sump that is connected to the main pump sump. Thus, if the main sump level falls, cyclone overflow flows back into circulation. If the sump level is at the desired point, the cyclone overflow exits from the small sump and leaves the circuit.

In the various lean ore plants on the Mesabi Range where minus ¼-in. by 65 mesh iron ore is concentrated in cyclones using magnetite medium, up to six 10-in. cyclones are operated from a common 10-in. diameter feed header. Because of severe abrasion, Ni-Hard or silicon carbide apex discs are used to regulate the apex diameter and these openings obviously cannot be readily adjusted. However, in most cases, adjustments in cyclone apertures are seldom required and control is largely by adjusting the density of the feed medium. Nozzle pressure usually is from 25 to 30 psi, but the operating range can be extended to as high as 40 psi and as low as 15 psi without drastic changes in results. It is expected that the use of previously-mentioned dual vortex finders will provide considerable control without shutting down to change apertures, and trials with such a cyclone are scheduled for next season.

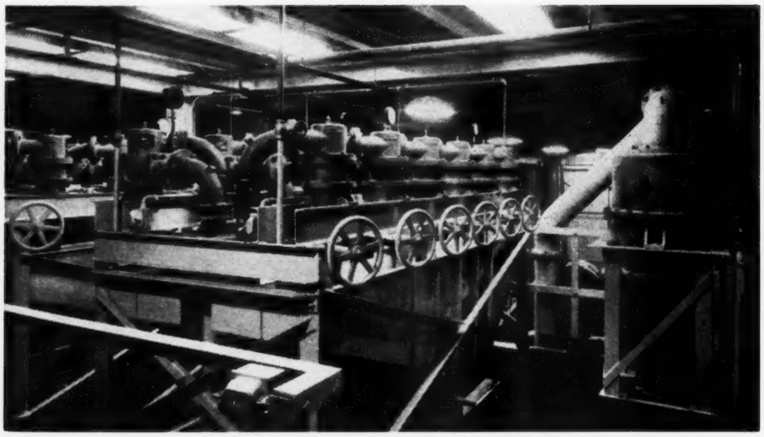
Cyclone Liner Material

Abrasion is a problem in cyclones and in the pumps feeding them, but ordinarily, by careful choice of material, it can be reduced to a minimum which is entirely acceptable from the point of maintenance cost and down time.

For most classification applications, rubber linings throughout are preferred. Points of maximum wear ordinarily are the apex and lower cone immediately above the apex, the feed inlet section at a point about 90°



In this installation cyclones separate slime tailings from primary rougher circuit



Cyclones used as desliming classifier

beyond the tangent of the feed opening and, in some cases, the inner surface of the vortex finder sleeve. Ni-Hard linings or castings also give good wear life and chilled Ni-Hard has been found to equal rubber and Linatex in life.

At the Erie Preliminary Taconite plant, where the ore feed ranks among the world's toughest and most abrasive materials, it appears that for minus ⅛-in. feed, thick rubber or Linatex will outwear ordinary Ni-Hard in points of maximum wear. Carborundum apex discs presently show superior wear life to either rubber or chilled Ni-Hard. Ni-Hard feed nozzles wear as well as rubber nozzles. Strangely enough, there is considerably less wear with circular nozzles than with rectangular nozzles.

Feed inlet section ¾-in. thick rubber liners appear to last for eight months, during which time each cyclone handles 300,000 tons of actual feed or the equivalent of 75,000 tons of crude mill feed. Ni-Hard apex discs last about two months, handling about ¼ of the above tonnages. Certain Silicon carbide apexes promise to exceed this wear considerably.

Wear-Life Analyzed

Feed pumps are 8-in. by 6-in. SRL-C rubber lined pumps. Each pump draws about 55 hp and operates at 930 rpm. Rubber parts wear-life is shown in Table I.

TABLE I

	Months	*Long tons Pumped*
(1) Impeller (closed type)	2 to 3	600,000
(2) Casing Plate	3 to 4	700,000
(3) Gland Side Liner	4	800,000
(4) Suction Side Liner	6	1,200,000

Parts 2, 3, and 4 can easily be rebuilt with Linatex and be reused to yield wear-life about equal to the initial wear-life.

The cyclones for the Erie Commercial Plant will consist of a mild steel shell lined with one in. thick replaceable rubber linings throughout except for silicon carbide apex discs and Ni-Hard vortex finders.

It is interesting to note that the rate of wear on rubber linings accelerates when the thickness decreases to less than ¼-in. and if the feed contains any amounts of ¼-in. material, Ni-Hard may outwear rubber.

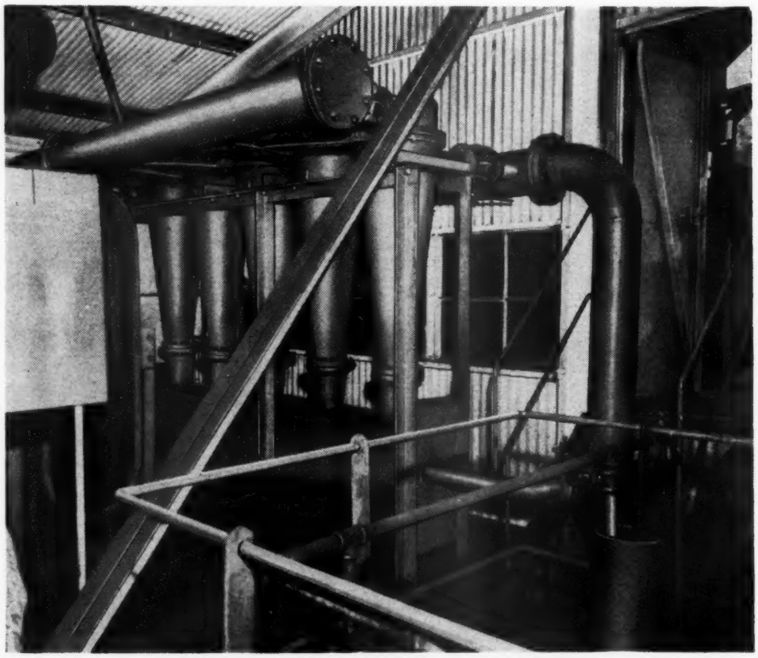
In the lean ore plants which separate minus ¼-in. by 65 mesh ore in magnetite medium, the preferred cyclone lining is Ni-Hard. Tests have been conducted with Linatex linings up to one in. thick but life was reported as not satisfactory. In the cyclone plants operated by Pickands, Mather & Co., the 10-in. ore separating cyclones are constructed of all Ni-Hard. The feed inlet sections are ⅛-in. mild steel shells enclosing ½-in. Ni-Hard liners and a Ni-Hard circular feed nozzle. Other parts are Ni-Hard castings. Carborundum apex discs are on trial and the results are encouraging.

Ni-Hard apex discs will maintain a satisfactory aperture dimension for the production of 2000 to 4000 tons of minus ¼-in. concentrates per cyclone. Lower cones will last two to three times as long. Feed nozzles appear to be good for 20,000 tons. (These wear figures may seem low but it should be remembered that for each ton of ore treated about 3.5 tons of magnetite media also are pumped through the cyclone.)

Standard Wilfley and Wemco six-in. and eight-in. sand pumps of all Ni-Hard construction are used. (Dilution water cannot be tolerated because of the necessity to control medium density.) In general, the follower plates are worn out first, then the impellers. Wear-life may average as shown in Table II.

TABLE II

Impellers	45,000 tons
Follower plates	17,000 tons
Case	90,000 tons



A battery of 14-in. cyclones used as thickeners

Some Roof Bolting Costs

With more than 4,000,000 bolts being installed monthly, roof bolting comes under the heading of big business

Data from 66 Bituminous Coal Mines on Bolting Procedure and Costs Point Out Some Interesting Facts

By GEORGE W. SALL

NEVER in the history of coal mining has a practice or idea taken hold in so short a time as has roof bolting. Latest U. S. Bureau of Mines figures show that bolting has grown to the point where over 3,000,000 roof bolts are installed in domestic coal mines monthly. Add to this figure the estimated 1,000,000 bolts installed monthly in metal and nonmetallic mines and the important part roof bolting plays in mining today can readily be seen.

Material upon which this article is based has been furnished by Ed Thomas, Mining Engineer in charge of Roof Control, U. S. Bureau of Mines.

In the almost explosive growth during the past few years of this method of roof support, many refinements of the art have not been fully developed. There was no need for it. Roof bolting itself offered such an advantage over conventional timbering methods, that not as much attention was paid to the various bolting operations as might have been the case if bolting had come along more slowly. Now, however, after having gained the first advantages of roof bolting, many operators are beginning to take a closer look at the integral parts of a bolting program.

Realizing that mine operators were beginning to look for improvements in the art of roof bolting, the U. S. Bureau of Mines in the summer of 1955 canvassed the industry for information on the various phases of the operation which might prove of interest and value. Information was gathered from 66 mines in nine States and is set forth in table I.

U. S. B. M. roof bolt specialists in the various bituminous coal mining areas were asked to answer a standard questionnaire on several mines in their territory. Since the data were collected by personal interview, the information can be assumed to be relatively consistent throughout.

Data Arranged Geographically

The information in table I is tabulated by geographical areas. At first, it was hoped that a grouping could be made in arranging the data so that the properties with similar drilling difficulties would be kept together. This, however, was impossible within the limited scope of the project and it was decided that the best possible arrangement would be by geographical areas.

The type of mine roof reported at each operation varied from shale to sandstone with some limestone, roof coal, draw slate and rash showing up. These materials reflect almost the entire range of resistance to drilling met in sedimentary rocks. Unfortunately, there is no direct way of comparing the drilling conditions at the different mines reported.

Rotary Drilling Most Popular

By far the most popular drilling method reported was dry rotary drilling. Although the question of whether or not dust collectors were used was not asked, it is assumed that where drilling is done dry some sort of dust collector is used. Of the 66 mines reporting, 38 use dry rotary drilling, 19 use dry percussion drilling, six use wet rotary drilling and four use wet percussion drilling. Some mines use more than one type of drilling, while three mines did not say whether wet or dry drilling is employed at three mines.

Among the interesting side remarks gathered during the survey was to the effect that at Mines No. 46 and 47 list cost has been reduced by an estimated ½ to ⅓ through the use of water in conjunction with rotary drilling.

A good comparison of bit costs in rotary and percussion drilling can be

ROOF BOLTING DATA COLLECTED FROM 66 BITUMINOUS COAL MINES

Mine No.	Seam Height	Mine Roof	Type of Drilling	Type of Bit	Bit Size Start	Bit Size Finish	Ft./Bit	Bit Cost	Holes/Bit	Depth of Hole	Cost of Bit/Ft. of Hole	Bolt Cost	Bolting Crew Size	Bolts/Shift/Crew	Are Bits Resharpened	Times Resharpened	Tonnage/Crew/Shift
Indiana, Illinois and West Kentucky																	
1	56"	Shale	R.* Dry	Carbide Tipped	1⅜"		—	4.09	—	36"	—	0.82	2	125	Y	—	400
2	72"	Shale & Lmst.	R. Dry	Carbide Tipped	1⅜"		—	4.20	—	18"–60"	—	0.89	2	70	Y	—	470
3	54"	Shale	R. Dry	Carbide Tipped	1⅝"	1⅜"	—	4.35	—	42"	—	0.82	2	125	Y	—	366
4	78"	Shale	R. Dry	Carbide Tipped	1⅜"		—	4.00	—	60"	—	1.25	2	45	Y	—	533
5	42"	Shale	R. Dry	Carbide Tipped	1⅜"		—	3.90	—	37"	—	0.72	1	50	Y	—	220
6	72"	Shale	R. Dry	Carbide Tipped	1⅜"		—	4.05	—	48"	—	0.89	2	150	Y	—	495
7	48"	Shale	R. Dry	Carbide Tipped	1½"	1⅜"	—	4.31	—	48"	—	0.95	2	65	Y	—	376
8	90"	Shale	R. Dry	Carbide Tipped	1⅜"		—	4.12	—	60"	—	1.20	2	55	Y	—	422
9	84"	Shale & Lmst.	R. Dry	Carbide Tipped	1½"	1⅜"	—	4.21	—	72"	—	1.20	2	74	Y	—	—
10	84"	Coal, Shale & Lmst.	R. Dry	Carbide Tipped	1⅝" 1½"	1⅜"	—	4.20	—	72"	—	1.30	2	66	Y	—	—
Western Pennsylvania																	
11	38"	Shale	R. Dry	Carbide Tipped	1½"	1⅜"	75'	4.50	25–30	38"	0.06	0.56	cutting crew	30	Y	6–7	140
12	60"	Shale S. S.	R. Dry	Carbide Tipped	1½"	1⅜"	25'	4.44	5–6	50"	0.18	0.88	1	65	Y	5	225
13	84"	Laminated	Per.† Dry	Throwaway	1⅜"	1¼"	20	0.195–0.285	4	68"	0.0098–0.0143	1.36	3	65	—	—	275
14	78"	Shale & S. S.	Per. Dry	Throwaway	1⅜"		35'	0.30	6	58"	0.009	0.91	2	30	—	—	175
15	84"	Laminated	Per. Dry	Throwaway	1½"	1⅜"	30'	0.30	6	66"	0.01	1.08	2	45	—	—	175 (clean)
16	84"	Laminated	Per. Dry	Throwaway	1½"	1⅜"	60'	0.28	8–10	66"	0.005	1.04	2	40	—	—	200–275
17	68"	Laminated	R. Dry	Carbide Tipped	1¾"	1⅜"	450'	4.70–7.15	175	60"	0.0104–0.0159	0.75	2	50	Y	6–8	255
18	38"	Shale	Per. Dry	Throwaway	1½"	1⅜"	150'	0.28	80–100	32"	0.002	0.58	2	45	—	—	150
19	72"	Laminated	R. Dry	Carbide Tipped	1½"	1⅜"	50'	5.15	10	50"	0.103	0.90	2	60	Y	5–6	185 (clean)
20	84"	Shale	R. Dry	Carbide-Tipped	1½"	1⅜"	300'	4.20	60	50"	0.014	0.94	2	65	Y	4	250
Northern West Virginia																	
21	90"	Soft Shale	R. Dry	Carbide Tipped	1½"	1⅜"	240'	4.29–3.94	18–20	60"	0.0164–0.0179	1.012	2	81	Y	4	450
22	90"	Soft Shale	R. Wet	Carbide Tipped	1¾"	1⅜"	308'	4.15	62	60"	0.0135	0.094	2	100–120	Y	5	490
23	60"	Shale	R. Dry	Carbide Tipped	1½"	1⅜"	1100' (est.)	5.05–4.45	330	42"	0.0045–0.0046	0.7627	2	80	Y	10 (est.)	300
24	84"	Shale	R. Wet	Carbide Tipped	1¾"	1⅜"	160'	4.02–4.25	40	48"	0.025–0.0266	0.9065	2	90	Y	5	470
25	108"	Soft Shale	R. Dry	Carbide Tipped	1⅞"	1⅜"	336'	4.25	84	48"	0.0126	0.88	1	84	Y	6	400
26	84"	Soft Shale	R. Dry	Carbide Tipped	1⅞"	1⅜"	300'	3.53	70	70"	0.0118	0.96	2	46	Y	7	326
22	84"	Soft Shale	R. Wet	Carbide Tipped	2"	1⅜"	900'	3.96–4.25	129	84"	0.0044–0.0047	1.244	2	67	Y	10	570
87	42"	Shale	R. Dry	Carbide Tipped	1½"	1⅜"	150'	4.67–4.45	60	30"	0.031–0.033	0.654	2	100	Y	6	300
Southern West Virginia																	
29	56"	Draw Rock	R.	Carbide Tipped	1⅝"	1⅜"	247'	5.22	62	48"	0.0212	0.875	2	78	Y	5	275
30	48"	Soft Shale	R. Dry	Carbide Tipped	1½"	1⅜"	1620'	4.90	500	40"	0.0030	0.734	1½	45	Y	15	200
31	36"	Sandy Shale	R. Dry	Carbide Tipped	1½"	1⅜"	100'	4.80–5.45	400–500	32"	0.048–0.0545	0.813	2	60	Y	20–25	150
32	44"	Sandy Shale	Per. Wet & Dry	Throwaway	1⅜"	1¼"	30'	0.22		30"	0.0733	0.742	1	43	—	—	200
33	39"	Shale	Per. Wet & Dry	Throwaway	1⅞" 1⅝"	1¼"		0.18–0.23		36"		0.783	2	35	—	—	80
34	45"	Shale	R.	Carbide Tipped	1⅝"	1⅜"	300'	4.55	60	60"	0.0152	0.92	2	45	—	—	202
35	42"	Rash & Bone	R Wet Per. Dry	Carbide Tipped Throwaway	1½"	1⅜"	450'–900' 40'–80'	4.44 0.16	25–50 10–20	54"	0.005–0.0099 0.002–0.004	0.98	2	60–100	Y	4	—
36	66"	Shale & S. S.	Per.	Throwaway			3-2/3'	0.19	1	44"	0.052	1.41	3	70	—	—	250
37	70"	Shale & S. S.	Per. Dry	Throwaway	1½"	1⅜"	50'	0.20	13	48"	0.004	0.94	2	75	—	—	235
38	62"	Shale	Per. Dry	Throwaway	1½"	1⅜"	50'	0.20	13	48"	0.004	0.94	2	80	—	—	242
39	66"–120"	Shale & Coal	R. Wet Per. Dry	Carbide Tipped Throwaway	1½"	1⅜"	400'–900' 80'–100'	4.44 0.16	80–180 20–25	60"	0.005–0.011 0.0016–0.002	0.98	2	75–120	Y	4	—
Eastern Kentucky and Virginia																	
40	120"	Shale & S. S.	Per. Dry	Throwaway	1⅜"	1¼"	16.7'	0.24	3+	60"	0.0144	1.46	2	35	No	—	475
41	72"–144"	Shale & S. S.	R. Dry	Carbide Tipped	1⅜"		73.5'	4.44	17	51.6"	0.0604	0.86	2	100	Y	—	425
42	50"	Draw Rock & Shale	R. Dry	Carbide Tipped	1½"	1⅜"	130'	4.16+	37	42"	0.032	0.80	2	70	Y	16	231
43	42"–60"	Shale & S. S.	R. Dry	Carbide Tipped	1⅜"		400'	4.44	133	36"	0.0111	0.72	2	80	Y	20	230
44	52"	Shale	R. Dry	Carbide Tipped	1½"	1⅜"	275'	4.40	78	42"	0.016	0.80	2	80	Y	16	250 (clean)
45	48"–78"	Shale	R. Dry Per. Dry	Carbide Tipped Throwaway			88.8' 120'	4.44 0.24	25 34	48"	0.050 0.002	1.02	2	50	Y	11	150–300
46		Shale	R. Wet	Carbide Tipped	1½"	1⅜"	242'	3.95	69	42"	0.0163	0.70	2	84	Y	22	275
47	50"	Shale	R. Wet	Carbide Tipped	1½"	1⅜"	263'	3.95	75	42"	0.015	0.70	2	70	Y	22	260
48	72"	Shale & S. S.	R. Dry	Carbide Tipped	1½"		92'	4.50	26	42"	0.049	0.81	2	60	Y	8–11	286
49	72"	Shale & S. S.	Per.	Throwaway	1½"	1⅜"	80'	0.24	21	48"	0.003	0.95	2	59	—	—	325
Central Pennsylvania																	
50	66"	Shale	Per. Dry	Carbide Insert	1⅜"		1000'	11.50	260–280	47"	0.0115	0.8725	2	70–75	No	—	250
51	46"–52"	Shale or S. S.	Per. Dry	Carbide Insert	1¼"		900'	11.15	220–230	46½"	0.0124	1.145	2	40–45	No	—	—
52	52"	Shale	R. Dry	Carbide Tipped	1⅜"		1000'	4.90	275	46"	0.0049	0.77	cutting crew	4–12	Y	8–12	—

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							Central Pennsylvania (Continued)										
53	52"	Slate or Shale	R. Dry	Carbide Tipped	1⅜"		150'	3.50	50	36"	0.0233	0.8075	2	100	Y	7-10	275
54	54"	Sandy Shale	Per. Dry	Throwaway	1⅜"		60'	0.228	16	42"	0.0038	0.821	2	50-60	No	—	175
							Ohio and West Virginia Panhandle										
55	62"	Draw Slate	R. Dry	Carbide Tipped	1⅜"		665'	4.30	148	54"	0.0065	1.05	2	75	Y	6	355
56	48"	Shale	R. Dry	Carbide Tipped	1⅜"		117'	4.30	39	36"	0.0368	0.7495	1	60	Y	6	300
57	58"	Roof Coal	R. Dry	Carbide Tipped	1¾"	1⅜"	488'	4.30	163	36"	0.0088	1.053	1	46	Y	10	195
58	72"	Shale	R. Dry	Carbide Tipped	1⅜"		242'	4.05	66	44"	0.0167	0.7372	2	50	Y	4	300
59	63"	Roof Coal	R. Dry	Carbide Tipped	1⅝"	1⅜"	612'	4.30	106	69"	0.0071	1.143	1	40	Y	10	150
							Alabama and Tennessee										
60	67"-93"	Sandy Shale	Per. Dry	Throwaway	1-7/16"	1⅜"	—	—	—	48"-94"	—	—	2	60	No	—	475
61	62"-78"	Sandy Shale & S. S.	Per. Dry	Throwaway	1⅜"	1-5/16"	—	—	—	31"-36"	—	—	2	40-60	No	—	450
62	60"-72"	Shale & S. S.	Per. Dry	Throwaway	1⅝"	1⅜"	109'	—	22-27	46"-58"	0.00227	1.29	2	90-100	No	—	415
63	54"	Shale	R. Dry	Carbide Tipped	1-7/16"	1⅜"	600'	—	200	37"	—	0.61	2	70	Y	20	336
64	54"	Shale & S. S.	R. Wet	Carbide Tipped	1⅜"		3'-600'	4.25	1-240	33"	—	0.72	1	35	Y	6	452
65	72"	Shale & S. S.	Per. Wet	Throwaway	1⅜"	1¼"	14'	0.227	3.65	46"	0.0163	0.9419	2	60	No	—	400
66	60"	Shale & S. S.	Per. Wet	Throwaway	1⅜"		24'	0.44	6	50"	0.015	0.82	3	70	Y	2	364

* Rotary
† Percussion.

obtained at the few mines using both types. Mines No. 35, 39 and 45 are examples.

Bits and Bit Sizes

For the purposes of this report, the type of bit is classified as either carbide tipped, or throwaway. All mines reporting use carbide tipped bits, although information was not gathered as to whether these are finger type bits or diamond point bits. At all coal operations reporting percussion drilling for roof bolting, except for two, throwaway type bits are used. The two nonconformists are Mines No. 51 and 52 where carbide insert bits are used.

By far the most popular bit size is 1⅜-in. among the companies surveyed. That was the bit size used to finish most of the holes, although in some isolated examples 1¼-in. bits were used as finishing bits. Of the 66 mines reporting, 44 start roof bolt holes with larger bits than are used to finish the holes. In two cases, Mines No. 10 and 33, three bit sizes were used in drilling one hole. At one operation, Mine No. 57, roof bolt holes are started with coal bits that have worn under the 1¾-in. gauge needed for coal drilling. In table I, wherever only one size bit is shown, that should be considered as both the starting and finishing size.

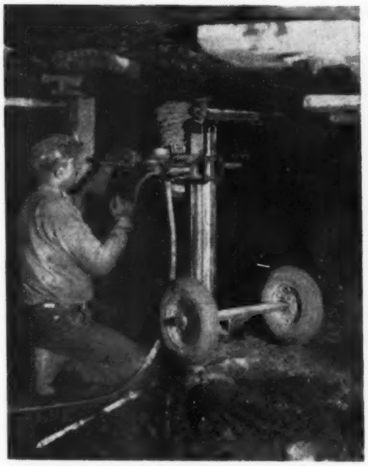
Drilling footage per bit, of course, varies considerably. It not only varies throughout an area but they can vary widely in one operation. For example Mine No. 64 gets as low as 3 and as high as 600 ft of hole per bit. Mines No. 34 and 38 also report wide variations. In all three of these operations local conditions are the governing factor.

Material Costs

Bit cost per foot of hole is calculated on the basis of furnished data. The one thing to keep in mind when inspecting these costs is that in addition to the original cost, if a bit is resharpened that cost should also be considered. In table I this is not done because there was not enough information available on resharpening costs. Two operations, Mines No. 12 and 19, the only two mines from which information on the cost of regrinding is reported, show a cost of $0.21 per regrind.

Bit costs per foot of hole of under one cent are not all uncommon, while at one operation, Mine No. 12, the bit cost is given as 18 cents per foot of hole.

In comparing bit costs per foot of hole according to type of drilling, percussion drilling shows a lower cost. The same comparison also shows up in properties using both percussion and rotary drilling. A comment that appears often in the questionaires is to the effect that bit performance



Dry, rotary drilling has proved to be the most popular method of putting in roof bolt holes

depends to a great degree upon the skill of the drill operator.

Cost of the roof bolts at the mines surveyed varies widely, depending in part on length of bolt, size of bolt, type of bolt, and distance from a supplier. In gathering this information the question was asked, "What is the cost of each bolt at the mine (complete)?" The bolt costs posted in table I, therefore, are assumed to include the entire bolt assembly. These costs do not include such materials as wood in bearing plates or steel ties which are used in some applications. Some mines reported that bolts are recovered and reused, but this saving is not taken into account in table I.

Two-Man Bolting Crews

By far the most prevalent practice as far as bolting crew size is concerned is to use two men to a crew. These men will install up to 150 bolts per shift. The average is close to 65, however. Eight mines reported using a one-man roof bolting crew, and three use a three-man crew. At Mines No. 11 and 53, hand loading operations, the cutting crew installs bolts as part of their work.

Bit resharpening practice varies considerably although there is some measure of consistency within a particular geographical area. The average number of regrinds for carbide tipped rotary drill bits is 9.5 with some mines getting only four and others up to 25. At some of the properties surveyed this type of information is not collected by mine management and was not available.

It is apparent from a study of table I that some mine operators are making progress toward a refinement of roof bolting practices. Others, however, it appears are not getting the full advantage of their roof bolting dollar.

Atomic-powered submarines may be the forerunner of atomic propulsion in surface ships and aircraft

WANTED: A Long-Range Policy For the Uranium Mining Industry

A Significant Study of Conditions Vital to the Future of Uranium Mining

By SENATOR CLINTON P. ANDERSON
Chairman
Joint Committee on Atomic Energy

THIS article treats the subject of the policies needed to maintain a strong domestic uranium industry. Maybe you would let me ask: "Miners, do we boom or bust?"

That's not a bad question. *American Mercury* magazine in its issue for September 1955, has an article entitled, "The Coming Uranium Bust." The author quotes with some approval from a 1952 report of a raw materials subcommittee of the Joint Congressional Committee on Atomic Energy; and since I was chairman of that subcommittee, courtesy would seem to require that I quote him pleasantly or not at all. He says that our report warned the AEC that no uranium shortage would be excused, and "thus began the uranium rush." In all modesty, I must suggest that he gives us a little too much credit! There must have been other factors that also influenced prospectors.

Do we boom or bust? Ralph Lapp, director of Nuclear Science Service in Washington, on September 20 told a convention at White Sulphur Springs, W. Va., that our stockpile of atom bombs "amounts to several tons of TNT for every inhabitant of our planet" and then predicted a sharp slump in the uranium market for weapons in the next decade.

That helps you understand why I ask: Do we boom or bust?

After 1962?

As all of you know, the Atomic Energy Commission has encouraged the production of uranium ores through a guaranteed buying program. The termination date of that program has been progressively extended—first to 1954 and then to 1958. Today, it extends until 1962.

But what of the years beyond 1962? Can our miners look forward to a long period of profitable operations, will the bottom fall out of the uranium market in 1963? You and I would like to be sure of the answers to these questions.

There is yet another question: What about the announcement of the Canadian government that it would not provide a guaranteed market for uranium for mines coming into production after 1957? Does it mean that the saturation point in uranium output may be close at hand?

The heart problem faced by our uranium producers can be simply stated. Today, the market for uranium ores is almost exclusively a military market, as Dr. Lapp rightly guessed. The civilian atomic power market will of course grow in size and importance over the years. But as of today—and for at least the next decade—it will be a limited market from the standpoint of the uranium producer. The $100 million question for the mining industry therefore comes down to this: How long will the military market for uranium ores hold up—and how rapidly will the civilian power market grow? Can there be a slow, orderly, and healthy transition from one market to the other?

Part of the answer is that the immediate future poses no great worries for uranium producers. The vast atomic plant expansion program authorized by the Congress in 1952 is not yet completed. For the time being, and for the years immediately ahead also, we will need all the uranium ore we can get if we are to meet the atomic weapons goal set forth by our defense planners.

Military Needs

But now let's peer somewhat further into the future—say to 1965 or 1970. Competent students of military strategy argue that by 1965, to choose an arbitrary date, the nuclear weapons stockpile of the United States will be large, efficient, and versatile enough to meet any possible military contingency. Such people maintain, in other words, that in perhaps another ten years we will have so many atomic and hydrogen bombs in so many shapes, sizes and capabilities that the

production of additional special nuclear material for military purposes will be pointless. Accordingly, they see a very rapid fall off in the military's requirement for uranium ores. Are they right or wrong?

Let me warn you now that I am a layman in military matters. Only the Joint Chiefs of Staff can speak authoritatively concerning the military's requirements for special nuclear materials in the years ahead. However, I believe that our output of nuclear weapons may remain on a high level for an indefinite period to come, chiefly because we steadily find new military applications and hence, design and build new devices.

Time and again in the past, we have underestimated our need for atomic and hydrogen weapons. It should not be surprising if those who now predict atomic weapons' saturation by 1965 are again proved wrong.

Think back ten years—to the days immediately following Hiroshima. It was widely believed within the military establishment that, within two or three years, we would amass enough atomic bombs to satisfy any conceivable military requirement. Yet today our atomic weapons' production capacity has had to expand greatly—and our plants for producing special nuclear material are continuing to go full blast. In 1945 most of us thought of atomic bombs exclusively as strategic weapons to be employed against a few large industrial targets. Today, tactical applications of atomic weapons threaten to overshadow their strategic use. In 1945, most students of military affairs would have regarded the idea of atomic "ack-ack" as wildly visionary and impractical, yet today we are developing atomic warheads specifically designed to destroy enemy planes in the air.

Next take the field of nuclear propulsion for naval vessels and military aircraft. Two magnificent atomic submarines, the *U.S.S. Nautilus* and the *U.S.S. Sea Wolf*, have been launched. In my opinion, the time is nearing when virtually all the ships in our Navy will run on atomic reactors—meaning more business for the uranium mining industry. The time is also approaching when atomic propulsion will revolutionize air war, and when the chemical bomber will yield to planes running on nuclear fuels—again meaning more business for the uranium mining industry.

Hon. Clinton P. Anderson
Senator from
New Mexico

Civilian Atomic Power

Now what of possible future requirements for uranium ore on the civilian side—from the atomic power industry? As you know, the technical feasibility of generating useful power from the atom has long been established. It is also now clearly established that, as of today, atomic power would not be generally competitive with electricity secured from coal or oil or hydroelectric facilities. Authorities also agree that perhaps another ten years of hard work at cost-cutting will be necessary before atomic reactors are efficient enough to be a major factor in meeting our power needs. Progress is needed in this field if it is to mean more uranium business in the meantime.

To make useful estimates concerning the future of atomic power beyond 1965, we must try prophecy, at the risk of having the future make fools of us. We must attempt to guess how rapidly the world's over-all requirements for energy will grow. So let's begin with some predictions which appear relatively sure: First, the experts say that the first doubling of the world's population took 950 years —from 700 A. D. to 1650 A. D., the next doubling required only 200 years, and a third doubling took only 100 years—from 1850 to 1950. The next doubling, the experts go on, should take even less—85 years—or possibly even sooner. In 1953, the population of the world was slightly over two and a half billion. In the year 2050, seven billion persons may inhabit the world.

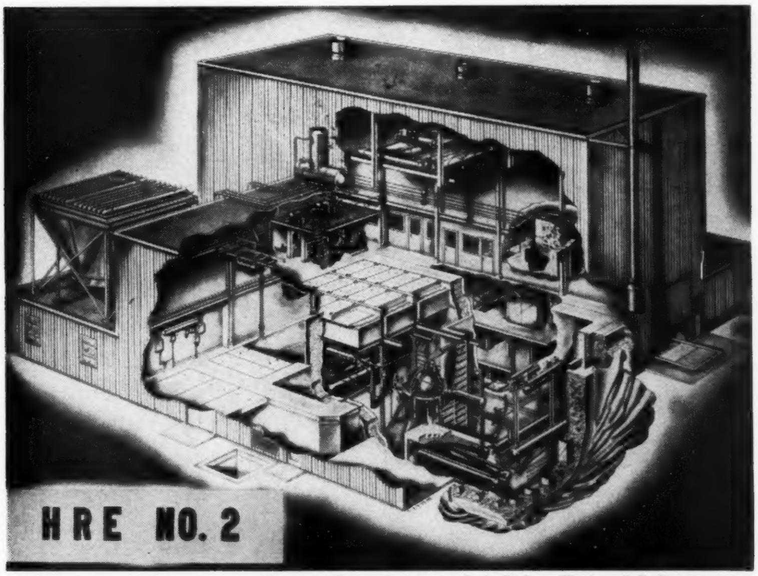
This means that world energy consumption should soar upward. So the experts predict that by the year 2000, the world will be consuming annually five times as much energy as it is today.

How much of this energy will come from atomic power? To answer this, we must first answer another question: How rapidly will the costs of atomic power go down as our knowledge of the reactor art increases?

Reactors now being constructed and designed eventually will be regarded as Model T devices. Every new generation of reactors will incorporate improvements — making for cheaper electricity.

Projecting these improvements into the future, the experts find that by 1975 perhaps a quarter of the new generating capacity installed each year in our country will use atomic fuel. By the end of this century, perhaps 90 per cent of the new central station generating capacity installed each year will run on atomic power.

The figures I have just cited, however, apply to the United States. We Americans have been generously endowed by nature with cheap conventional fuel resources. Accordingly, atomic power really has its work cut out in trying to gain a foothold in the American power market.



Sketch of a Homogeneous Reactor Experiment at Oak Ridge National Laboratory

The Foreign Outlook

Abroad, this situation is completely different—and completely more favorable to an early transition from conventional to atomic power. Europe's

Uranium mill at Monticello, Utah

cheapest reserves are exhausted, particularly in England. Oil? Europe is a heavy importer of oil. Hydroelectric facilities? Europe has no Tennessee, Missouri or Columbia rivers waiting to be harnessed. The results are reflected in power costs. In our country, electricity costs an average of about 7 mills per kilowatt hour when it leaves the generating station. In France, Denmark and the Netherlands the comparable figure is 13 mills, and in Turkey electricity costs over 20 mills per kilowatt hour.

In the economically underdeveloped areas of the world, power costs are even higher. Over most of Asia, Africa, and Latin America, abundant and accessible conventional fuel simply does not exist. Do you realize, for instance, that 75 per cent of India's total energy now comes from cow dung?

In these regions of the world, atomic power is not merely a modest economic asset. It is not merely something reflected in a smaller electric bill, or in lower costs for industrial goods. In the economically backward areas, atomic power is an imperative for economic progress. Dr. Homi Bhabha, the brilliant Indian scientist who served as president of the Geneva atomic conference, put it this way: "For the full industrialization of the underdeveloped countries . . . atomic energy is not merely an aid; it is an absolute necessity." All this adds up to the confident prediction that in Europe, and on the other continents, atomic power will be competitive or essential sooner than in our own nation.

Now as members of the mining industry, your concern is, of course, with the question of what all these statistics mean in terms of requirements for uranium ore. For help on this score, turn to some estimates made last year by Jesse Johnson, director of the Division of Raw Materials at the Atomic Energy Commission. Mr. Johnson predicted that the nuclear power industry of the free world would require fourteen thousand tons of uranium metal a year by 1975 or 1980. This would be the rough equivalent of seventeen thousand tons of uranium oxide.

My own guess—and I warn you it is only a guess—is that these estimates of seventeen thousand tons of uranium oxide in 1975 or 1980 are too conservative. My own hunch is that the free world will need this amount of uranium for civilian power well before 1975. My own hunch is that we are still selling the future of atomic power short—that we still do not anticipate how rapidly the price of electricity from the atom will go down, and the demand for atomic energy, particularly in propulsion devices, will go up.

My own guess, furthermore, is that we are now overlooking the tremendous market for atomic materials which may develop in the field of radiation as an industrial process. No man can now predict how big this market will be in 10 or 20 years—but it may be very large indeed.

Policy Statement from AEC

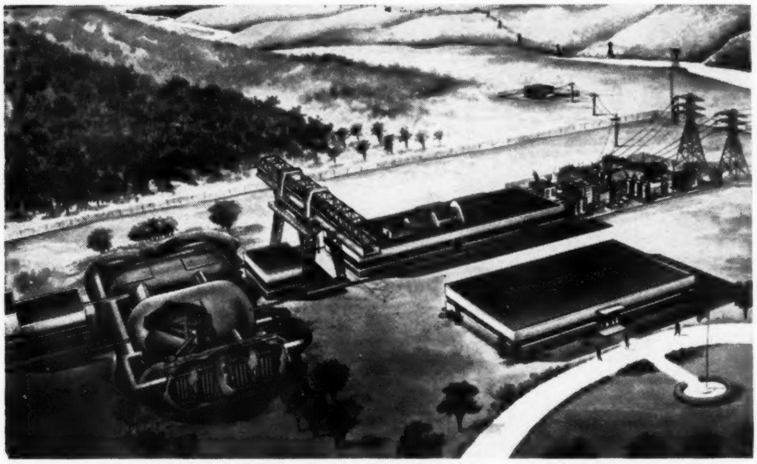
Now let me try, if I may, to read what may now be in the minds of some of you. Are you saying: "It is well enough to talk about civilian uranium ore requirements in 1975 or 1980—but what of these same requirements in 1965 or 1970?" Do you ask: "Why talk of the market for uranium *after* atomic power reactors are competitive with conventional electricity? What about this market *before* they are competitive?" You ask: "How do we, as uranium producers, get through the 1960's?"

These are fair questions—and they need one forthright and responsible answer. Where can such an answer come from?

Some of you may know that a few months ago the Joint Committee appointed a special panel of consultants on the Impact of Peacetime Uses of Atomic Energy. This panel includes some of America's outstanding industrialists. One of the questions the panel is examining is the possible future dimensions of the civilian market for uranium ores. The panel hopes to issue a report early in 1956, and its findings should prove of real use to the uranium industry. It may give you part of the answer.

Likewise, the Atomic Energy Commission is trying to make more accurate estimates concerning the long-term market for uranium ore. Such estimates are inevitably difficult—they involve a great many imponderables. I hope, nonetheless, that the Commission will accelerate the rate and scale

Part of the facilities of the Knolls Atomic Laboratory, operated by the General Electric Co. for the Atomic Energy Commission



Artist's sketch of a central station nuclear power plant

of its studies in this area and will find itself able to publish the most authoritative estimates possible concerning future prospects for our uranium mines, and announce in clear and precise words what miners of uranium can count upon. In other words, the Commission by this spring should issue a formal government statement explaining if it wants uranium and in what years and at what prices.

Hydrogen Power Considered

I cannot close these remarks without referring to a matter which now appears to be causing the uranium industry much concern, but a matter which should really cause it no concern whatsoever. I refer to the possibility of building hydrogen power reactors.

Now I am on record as favoring the most vigorous effort possible to see whether the H-bomb can be harnessed for constructive ends. Nonetheless, I do not believe for an instant that success on this score would jeopardize the future of the uranium mining industry.

No man can say for certain that a hydrogen reactor can ever be built. As of today, we still lack the key ideas which would make construction of such a machine possible. Conceivably, we may never discover these key ideas —although I think we will.

The important point, however, is this: Even if we had some great breakthrough in the controlled hydrogen field next year, decades would probably elapse before a practicable hydrogen reactor could be built.

Let me try to tell you why. The history of the development of nuclear power from fission illustrates the growth of a basic idea into an important influence on human economy.

The possibility of obtaining energy from the atomic nucleus, either by fusion or fission, has been apparent for more than 25 years. The first actual uranium fission was accomplished in 1934. By June 1940, knowledge of uranium fission was general, its energy release had been measured, and its possible applications for power production and bomb use had been clearly recognized. The path of investigation was clear, leading to the first atomic pile operation in 1942.

Economics of Hydrogen Power

How long the normal development of nuclear power would have taken can only be guessed, because the military possibilities of uranium fission at this point caused nuclear development to become an all-out effort with nearly unlimited funds, priorities, and zeal. Information was obtained at a tremendously accelerated rate compared with normal industrial development.

The ensuing postwar support of power reactor development by the American government has perhaps been sustained largely from a feeling of responsibility for the force which it had unleashed, and a desire to provide a peaceful harness as well. Certainly there has been no powerful economic nor military incentive to develop power reactors, as this country is not short of conventional power potentialities.

In view of the intensified wartime effort, and the government-sponsored peacetime development, the atomic power art is now many years ahead of its likely position with a normal advance of knowledge. It will be several years before a power reactor is built which returns a profit to someone.

The possibility of power from thermonuclear processes is clearly recognized, but the attainment of a sustained controlled power-producing reaction is probably much farther from basic understanding than was fission power in 1940.

It is quite possible that if the basic scientific understanding were achieved today, it might still be longer than 50 years before a profitable thermonuclear power plant were built. The reason for this is that there is less economic incentive to produce thermonuclear power than to produce fission power.

Here is why: Fuel alone is usually only one-fourth or one-third of the total cost of electric power today. Power breeder reactors offer the possibility of reducing the fuel cost by tenfold or more. Thus if thermonuclear power could be developed to the ultimate point where fuel costs were essentially zero, the cost of delivered power would be cut only about 2 mills, *even if the investment required per kilowatt were the same.*

Some Technical Difficulties

As of today, thermonuclear reactions can be propagated only at extremely high temperatures (millions of degrees). It is difficult to find suitable materials to withstand the few hundred degrees' temperature of present power reactors. There is not likely to be a simple solution to containing the higher thermonuclear temperatures. Radiation produced in thermonuclear reactions is as intense as in a fission reaction. Therefore, the heavy shielding and extreme temperatures may make a thermonuclear plant extremely large, heavy, and expensive, with capital costs offsetting the absence of fuel costs. If this is the case, it probably could never take the place of a compact fission power plant for mobile use, and probably never could be used in the propulsion field, such as airplane, submarine, merchant ship or locomotive, leaving these fields to fission fuels such as uranium.

Because of the small gain from lowering of fuel costs, the thermonuclear plant might exist today and yet be only a curiosity to be put aside until scarcity of other fuels forced its use.

I am completely confident that fusion power will bear the same relation to fission power as the latter will bear to conventional power. Growing requirements for energy from all sources throughout the world will be so great that all producers of energy will have their hands full simply in trying to keep up with increasing demand.

It is up to you—the representatives of the mining industry of America—to produce the uranium ore we need for the security and welfare of our nation. But it is up to the Government to make sure that we have a long-range national policy for uranium mining which will benefit both the industry and our nation. May we in Congress join hands with you in seeking to work out with the Atomic Energy Commission, whose policy thus far has produced the needed flow of ore, a continuance of that wisdom and vision which will add strength to our country's arm.

Coal Plays Vital Part in Location of Aluminum Reduction Plant

A Development of Considerable Encouragement to Coal Operators Has Been Started in the Ohio Valley. This Location Was Chosen in Preference to Gas and Oil Fields as the Large Reserves of Minable Coal Insure Adequate Electric Power for the Years to Come

A NEW $280,000,000 expansion program has been inaugurated by Kaiser Aluminum & Chemical Corp. that will bring the company's total primary aluminum capacity up to 654,000 tons (1,308,000,000 lb) per year. This is according to an announcement by D. A. Rhoades, the corporation's vice-president and general manager.

A major project under the new program will be construction of a 220,000-ton aluminum reduction plant at Ravenswood, W. Va., to cost $120,000,000. This is to be located immediately adjacent to the sheet and foil rolling mill now under construction. It will be connected by economic water transportation with the company's alumina plants and bauxite mines, thus providing a direct flow of raw material. Over-all freight savings will be substantial, and will result in a highly favorable combination of transportation and power costs at the new plant. Perhaps the most important factor of all is the assurance of an adequate long-range supply of economical power derived from coal which will be supplied by the Ohio Power Co., an operating subsidiary of the American Gas and Electric Co. The power contract with the Ohio Power Co. provides for the availability of 450,000 kilowatts for a period of 40 years.

Comments on the significance of the power contract by Philip Sporn, president of the American Gas and Electric Co., are summarized herewith.

The agreement that brings a great reduction operation to Ravenswood marks the culmination of more than six years of planning and negotiation between the two companies. Their earlier determination to locate a major rolling mill operation at Ravenswood was based, in part at least, upon the prospects that an economical reduction operation might also be developed there if previous work carried out by the two companies could be built on and further expanded.

The decision to proceed with such a reduction operation, therefore, will utilize in every way the great resources, human and material, resident in the Ohio Valley to bring about one of the greatest aluminum operations in the country. Its significance, both companies feel, is great not only from the standpoint of its immediate effect but, what is even more important, for what it promises in further aluminum operations in the Valley. With them, as time goes on, will come the development of a great many industries dependent upon and utilizing the raw and semi-finished material that will be produced at these aluminum centers.

Gas and Oil Costs Rising

Studies leading to the decision to locate its new reduction operation at Ravenswood had their beginning several years ago. The studies revolved around the related economics of fuel cost for electric power, consumed virtually as a raw material in aluminum production, vis-a-vis proximity to markets, and involved gas, oil, water power and coal.

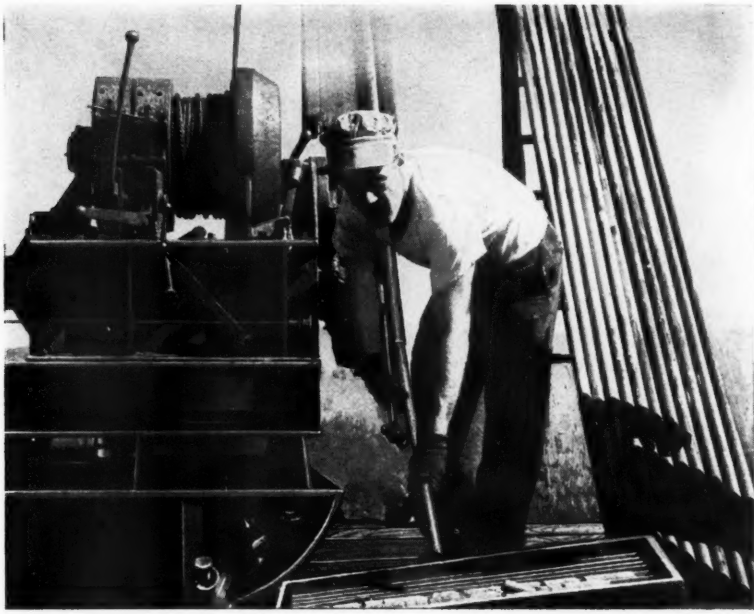
In the past decade, the greatest expansion in the chemical, electrochemical and electrometallurgical industries was climbing to new high levels in the Gulf Coast area because of its relatively cheap fuel. Meanwhile, however, new long-distance gas transmission lines were being laid down to carry the Southwest gas reserves to eastern, northern and western markets. As the demand for gas rose, so did the cost. It was soon evident that a point would be reached in the then not-distant future when the price of natural gas at the well would be pretty much in line with that of oil and with coal at the mine mouth. That point has been reached today. Further, indications are clear that the price of natural gas is bound to continue to rise.

As for water power, the diminishing number of remaining hydroelectric sites that are economically desirable, coupled with a severe limitation from which even the best of them suffer in being located remotely from centers of industrial activity and from markets, relatively makes hydro also unavailable as a source of large power supplies required for the coming expansion of the American aluminum industry. That is almost completely so as far as the United States is concerned.

But this brings coal and coal-based generation sharply into the picture. This picture is particularly bright where the coal reserves are ample and high-grade and where modern techniques of mining are introduced, since it makes possible a high level of productivity while maintaining the high wage level prevalent throughout the mining industry without bringing coal costs out of line. Where this coal lies on navigable water, and this is true in a large section of the Ohio Valley, it offers today an ideal combination of favorable economic factors for the development of large-scale, economical coal supplies required in large aluminum reduction operations.

From a long-range viewpoint this is even more promising. This is due to the fact that, where the coal reserves are ample, it is possible in many cases to develop operations at sites where reserves of from 50 to 100 years can be made available. To this is added the fact that the technology of steam-electric generation is not only in a very highly advanced state in the United States, but there is great promise of further advances.

All of these favorable factors exist in the Ohio Valley, and this makes the Valley a natural location for the expansion in United States aluminum production that is bound to take place in the next 10-20 years.



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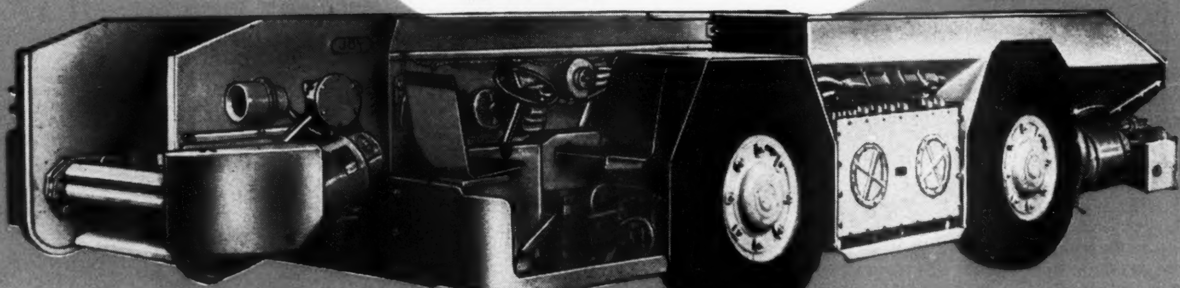

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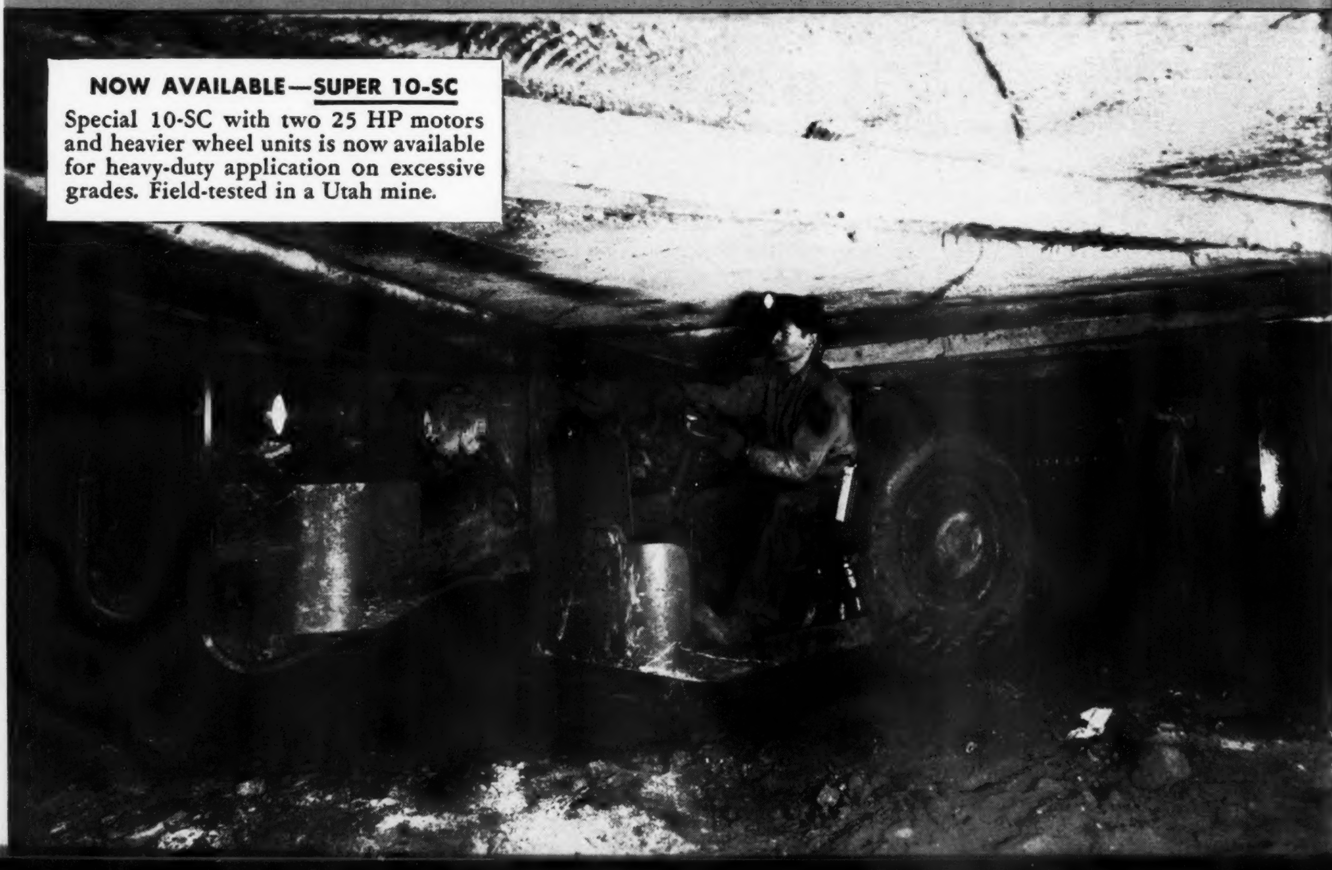

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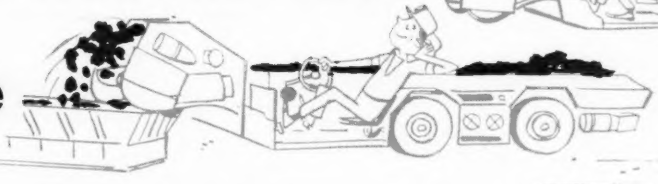

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Application of limestone-water slurry on coal rib

Experiments With Wet Rock Dusting

A Look at What the U.S.B.M. Has Found in Experimenting with This Method of Combating Dust Explosions Underground

By IRVING HARTMANN and JAMES WESTFIELD
U. S. Bureau of Mines

MODERN mechanized mining with high-speed machines, multiple entry systems, multiple blasting, high-velocity air currents, and rapid haulage has brought many economic benefits and has on the whole enhanced safety in the coal mining industry. It has, however, also introduced some added hazards, the control of which requires concerted effort and ingenuity. Mechanized mining has increased greatly the production and dissemination of fine coal dust in mine entries. Use of high-speed machines has increased the probability of formation of incentive sparks, which are produced by frictional contact between moving metals and certain mineral substances in the coal seam or in the adjoining rock strata. In gassy seams rapid extraction of coal has increased the rate of gas evolution.

These facts have made more urgent the need of preventing the ignition of coal dust and the development of widespread mine explosions. The ignition hazard can be controlled best by eliminating all potential igniting sources and by careful attention to ventilation, designed to prevent accumulation of gas capable of triggering a coal dust explosion. Extensive research and long experience have shown conclusively that the propagation of coal-dust flames can be arrested and the development of widespread explosions prevented by properly applied, generalized rock dusting.

Effective Rock Dusting

To be effective, rock dust must be applied uniformly and continuously on the rib and roof surfaces, as well as on the floor of coal mine entries. The rate of application must be adequate to raise the incombustible content of the mine dust to a minmum of 65 percent.

Experiments have shown that coal dust explosions in the mine entries can be quenched most successfully near their point of origin. Since most ignition sources occur at and near active coal faces, rock dusting in active entries must be carried as close to the face as possible, in any case at least to within 40 ft.

In operating mines fresh coal dust is produced at the active faces and by rib spalling, and dust is transported by the air currents during the active life of a mine. To neutralize this fresh dust on the mine surfaces, it is necessary from time to time to apply additional rock dust. An old but still valid recommendation is to rock-dust little but often. This promotes the mixing of rock dust with coal dust and makes rock dusting more effective.

How Much Rock Dust Is Needed?

The amount of rock dust needed to neutralize coal dust in a mine depends on the production of coal dust and particularly on the quantity of coal dust left below ground, on the incom-

bustible content of the coal dust, and on the amount of fine incombustible rock or clay material that mixes with the coal dust.

The production of coal dust is inherent in the mining process; it is produced during cutting, drilling, blasting, loading, haulage, man travel, and spalling of coal ribs. The quantity of coal dust produced varies greatly with the type of mining and with the nature of the coal seam and the surrounding strata. In continuous mining operations nearly all the coal is reduced to minus one-in. size, and as much as 20 percent of the total product might pass through a No. 20 U. S. Standard sieve; this fraction can propagate a coal-dust explosion. However, at present there are still comparatively few mines where continuous miners are employed. As an illustration of a more typical condition, consider a well-managed mine in a high-volatile coal seam which has a thickness of 64 in. This mine produces 12,000 tons of coal daily, working on three shifts. Part of the production is obtained on retreat and part on development, using an eight-entry (6 by 14 ft) system. Mine roof is supported with bolts. Coal is undercut and shear cut, and it is brought down with Airdox. It is mechanically loaded into shuttle cars, which in turn load six- to nine-ton mine cars to a level 18 in. above the car top. To allay dust, water sprays are used during cutting and drilling and at transfer points.

At this mine 25 percent (3000 tons) of the coal produced is of minus ⅜-in. size. Of this, 25 percent (750 tons) passes through a No. 20 sieve. Assuming that 90 percent of this dust is loaded out and 10 percent (75 tons daily) remains underground, it would take nearly 150 tons of rock dust to neutralize this explosive coal dust. This is equivalent to 25 lb of rock dust per ton of coal produced. Actually at this mine currently seven lb of rock dust is used per ton of coal (last year less than two lb per ton was used). This is a daily consumption of 42 tons of rock dust, an amount sufficient to neutralize about 25 tons of coal dust. This means that 97 percent of all the minus 20-mesh coal should be removed from the mine, which is most difficult to accomplish. Inherent incombustible in the coal and the inert dust from the roof and floor strata may help to neutralize some additional coal dust; but this may be offset by coal dust produced by sloughing of ribs and by disintegration of larger pieces of coal that are not removed initially from the mine.

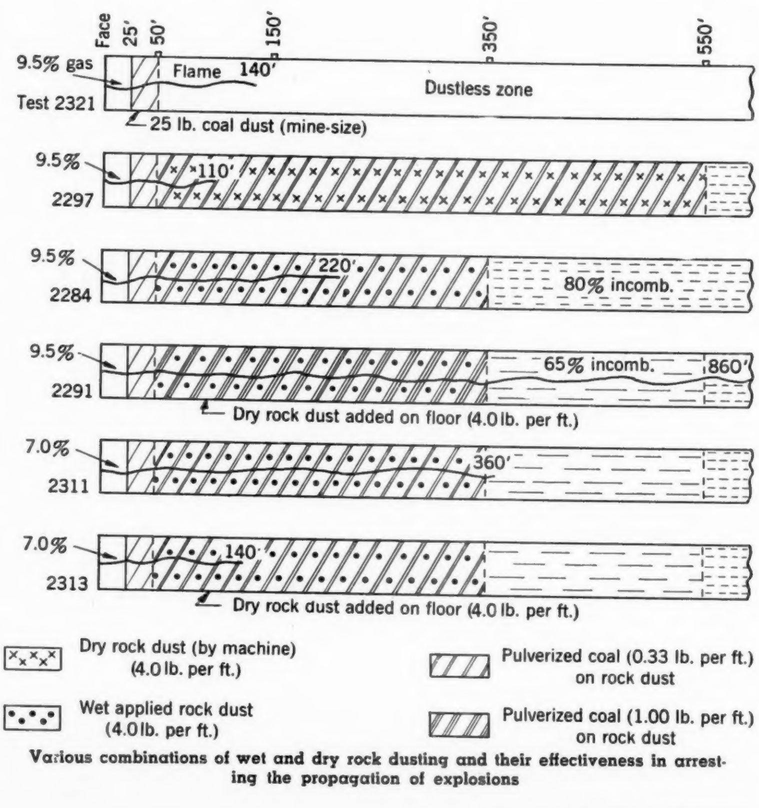
In considering this problem it should be pointed out that the vast majority of coal mines use less than five lb of rock dust per ton of coal and that part of this rock dust is frequently misapplied, as by excessive "blanket" rock dusting of the floor in certain entries. In the mine under discussion, about three tons of coal is mined per linear foot of entry. This means that an average of 21 lb of limestone dust is applied per foot; if, for the moment, limestone dust applied on the rib and roof surfaces is not considered, this represents a layer of limestone 0.3 in. in thickness on the floor. In some coal-mine entries limestone is applied on the floor to a depth of two in. and more; a one-in. layer of limestone one sq ft in area weighs about five lb. If in a 100-ft section of a 14-ft entry limestone is applied to a depth of two in. (140 lb per linear foot), it means that if the seam is about 62-64 in. thick and the average consumption of rock dust is seven lb per ton of coal, about 600 ft of entry in another section of the mine would be left without any rock dust whatever.

Float-Dust Problems

Consider next the float-dust problem at this mine. As has been stated, about 750 tons of minus 20-mesh coal dust is produced daily. Of this, normally about 20 percent or 150 tons will pass through a No. 200 sieve, a fraction that is highly explosive. Assuming that one percent (1.5 tons = 3000 lb = 48,000 oz) of this fine dust is transported and deposited along the entries by the air current as float dust, this amount of dust if uniformly distributed would daily provide a lower-explosive-limit mixture (0.05 oz per cu ft) in 960,000 cu ft of entry volume, or in about 1400 ft in each of the eight parallel entries. Of course the distribution of this coal dust is not uniform, most of it being deposited near the active faces. However, the illustration shows the importance of the float-dust problem, because even if only 0.1 percent instead of one percent of the through-200-mesh coal dust were disseminated by the air currents, a float-dust deposit equivalent to a lower-explosive-limit mixture might cover more than 100 ft in each of the eight entries daily. If the float dust were uniformly distributed on the ribs, roof, and floor in a 6 by 14-ft (= 84 cu ft) entry, at a concentration corresponding to 0.05 oz/cu ft, it would be equivalent to 0.1 oz per sq ft of surface, or a dust layer with an average thickness of less than 0.003 in. It is largely to neutralize this fresh float dust that mine entries should be re-rock-dusted periodically. The above example indicates the importance of making every effort to reduce the formation of fine coal dust during mining and to collect or promote the settling of dust near its source.

Improving Adherence of Rock Dust

During normal application with machines difficulties are often experienced in making the rock dust adhere to the roof and ribs, particularly if these surfaces are dry and smooth.



Various combinations of wet and dry rock dusting and their effectiveness in arresting the propagation of explosions

Tests have shown that, even with normally good adherence, not more than 30 to 35 percent of the limestone dust sticks to the ribs and roof; the balance falls chiefly on the floor, and some is carried away by the air current. A limited number of tests were performed in the Experimental coal mine in an attempt to increase rock-dust adherence.

One series of experiments was based on the idea that successive applications of small amounts of rock dust may result in greater adherence than a single application of a larger quantity. The tests were made in a mine entry seven ft high and 10 ft wide, with two ordinary limestones and one surface-treated limestone. The test data are plotted in figure 1. The curves have been drawn from the results of tests with successive applications of small amounts of limestone; the closed circles represent values (ribs and roof) from single applications of 4, 6 and 8 lb linear foot, respectively. The data indicate that from the standpoint of adherence it is largely immaterial whether a given amount of rock dust is applied in small, successive increments or whether application of a large amount is made at one time. The data also show that limestone A adheres to the rib and roof surfaces somewhat better than limestone B, and both of these adhere much better than the surface-treated limestone C.

Another series of experiments was made to determine whether wetting of the rib and roof surfaces might increase adherence of the rock dust. The wetting was accomplished in two ways, namely, by directing for a short time a fine water spray against the ribs and roof about 10 minutes before applying the rock dust; and by attaching a spray about 12 in. in front of the nozzle of the rock dust hose, so that the water reaches the surface just ahead of the rock dust. The water was applied at the rate of 0.15 to 0.2 gallon per linear foot of entry. The two methods of wetting gave nearly identical results. Figure 2 shows the effect of wetting on the adherence of the ordinary limestone A and the surface-treated limestone C. As can be seen, the adherence of limstone A on the rib-roof surfaces was increased by wetting from 32 to 45 per cent; the adherence of surface-treated limestone increased from about 14 to 27 percent.

A few experiments were also made in which dry limestone dust was applied on rib-roof surfaces that had been coated with limestone and subsequently became wet due to natural conditions. These tests showed that when dry rock dust is applied on such surfaces a very high proportion, ranging up to 50 percent for ordinary limestone, may adhere to the ribs and roof.

It is concluded from this study that,

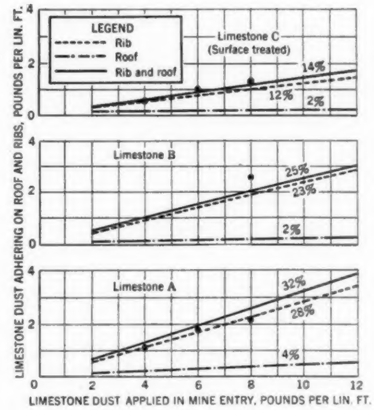


Fig. 1—Adherence of limestone dust on dry roof and rib surfaces of a mine entry (7 by 10 ft)

when difficulties are experienced in achieving good adherence of rock dust on ribs and roof of mine entries, slight moistening of these surfaces shortly before or simultaneously with the rock-dust application should be tried. In commercial mines it would be advisable to determine by trial which of the available limestone dusts is most suitable for this purpose and to what degree the ribs and roof should be wetted to achieve the desired results.

Wet Rock Dusting

The requirement that rock dusting in mine entries be carried to within 40 ft of active coal faces may necessitate the application of rock dust during a working shift. This is particularly true of highly mechanized mines, where continuous miners are used on three shifts and where a face may advance several hundred feet daily. Conventional rock dusting with machines is a dusty operation, and the dense dust clouds may affect the health of face workers and impair expensive mining machines. For this reason, in some mines rock dusting has not kept

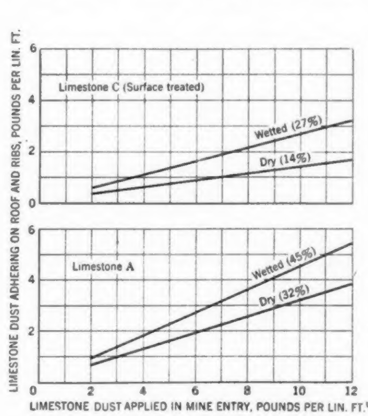


Fig. 2—Adherence of limestone dust on dry and wetted surfaces of mine entry (7 by 10 ft)

pace with the advance of the coal faces, and at times long sections of entries are left without rock dust.

To remedy the situation various substitute methods of rock dusting and other protective measures have been considered. One procedure involves the application of wet rock dust, either in the form of a premixed slurry or by mixing dry rock dust with water at the nozzle of a rock-dusting machine. The problem was investigated recently in the Experimental coal mine. The objectives of part of this study were:

(1) To determine whether wet rock dust could be applied practically in coal-mine entries without creating undesirable dust clouds; to find the proper ratio of rock dust to water; to find the least quantity necessary for a good covering of the rib and roof surfaces; to establish the degree of adherence; and to determine the rate of drying after application.

(2) To study the effectiveness of wetted rock dust, after partial or complete drying, in arresting the propagation of explosions.

The results of the preliminary study showed that:

(1) A premixed slurry of limestone and water fed from a guniting machine through a gunite nozzle can be applied effectively on mine surfaces and will produce very little dust in the air.

(2) Limestone dust fed from a guniting machine or from a commercial rock-dusting machine, mixed with water at the nozzle, can also be applied effectively and produces little dust in the air. A gunite nozzle was found suitable for this purpose. Application with the gunite machine gave a more uniform flow than the small rock-dusting machine, because the feed from the latter pulsated.

(3) A minimum of four lb of rock dust, applied wet, was needed per linear foot of entry (9 to 10 ft wide by 7 ft high) to cover the ribs and roof completely. Six gallons of water mixed with 100 lb of limestone gave a satisfactory mixture for nozzle application; the slurry required slightly more water. About 85 percent of the wetted rock dust adhered to the rib and roof surfaces.

(4) The rate of drying of the rock dust varied with the humidity and with the velocity of the air current. At normal air flow, at relative humidities below 80 percent the rock dust dried completely in 1 to 3 days; at humidities of 80 to 90 percent it dried in about one week; and at higher humidities several weeks were needed for drying.

(5) During dry rock dusting, when the air flow in the entry was maintained at 6000 CFM, the dust count 25 ft downstream from the nozzle was found to be as high as 5000 million particles per cu ft of air, and 100 ft

Distributing pulverized coal dust (1/3 lb per lineal foot) in wet rock dusted mine entry

downstream the count was about 2000 m.p./cu ft. When the slurry was applied the dust count was less than 0.5 percent of the above values; when limestone dust and water were mixed by a nozzle the dust count ranged from 1 to 10 percent of the above values.

Explosion Tests

Explosion tests were performed in the main entry of the Experimental coal mine. Explosions were initiated at the face of the entry either by a blown-out shot fired from the face into pulverized coal dust or by the ignition of a 25-ft-long gas-air mixture near the face. In most tests the rock-dust (limestone) zone started 50 ft from the face (due to the physical layout in the entry a 50-ft rather than 40-ft zone was used), and it extended several hundred feet along the entry. On the floor of the rock-dusted test zone dry rock dust was distributed by hand in several tests, but in a few tests this was not done. In a number of tests rock dusting was begun 100, 150, or 200 ft from the face; the portion of the entry between the zone of ignition and the start of the rock-dusted zone contained pure coal dust, or in a few cases it was a "dustless" zone.

After application and drying of the wetted rock dust a small amount of coal dust was distributed by hand over the rock-dusted surfaces. The aim was to simulate operating conditions in a coal mine, where fresh float dust is transported by the air current and deposited in the entries daily. To serve as a basis for judging the effectiveness of wetted rock dust, a number of tests were made with dry rock dusting. The results of the explosion tests indicated that:

(1) Dry rock dusting was more effective than wetted rock dust in arresting the propagation of explosions.

(2) Wetted rock dust was somewhat more effective after complete drying than after partial drying.

(3) Dry rock dust distributed on the floor in entries where wet rock dust had been applied on rib-roof surfaces helped greatly in limiting explosion propagation. The incombustible content of the floor dust should in no instance be less than 65 percent.

(4) The explosions were readily arrested when the rock-dusted zone started 50 ft from the face, except in one test in which finely pulverized coal dust at the rate of one lb per linear foot of entry (forming a cloud of 0.25 oz/cu ft concentration, if all were dispersed) had been applied over the wetted rock dust.

(5) When rock dusting was started within 100 ft of the face, difficulty was encountered in stopping some explosions; when the rock dust zone started 150 or 200 ft from the face, it was most difficult if not impossible to stop explosions.

Conclusions

The adherence of wetted rock dust to mine surfaces is better than that of dry rock dust, but its dispersibility and its mixing with coal dust are less complete. For this reason, the potential hazard of a superficial layer of float dust on the rock-dusted surfaces will be greater than in normally rock-dusted areas. In weak explosions this float dust, but little if any of the rock dust beneath it, might be dispersed, and the explosion could propagate for a long distance.

Pending the outcome of the current study, it is recommended that a close check should be kept on the condition of wet rock dusted surfaces. It should be noted that when the rock dust begins to spall appreciably off the ribs and roof this indicates that fresh rock dust should be applied. It should also be observed at what rate float dust is being deposited. This can often be noted visually by darkening of the rock-dusted surfaces. In addition, float dust might be collected on horizontal trays of known areas, attached at various locations near the ribs. From the weight of the dust the amount deposited per unit area of the entry surfaces can be computed and from this information the average concentration of float dust per unit volume of entry determined. When this concentration reaches about one-half of the lower explosive limit of coal dust, that is, a value of 0.025 oz/cu ft, serious consideration should be given to the application of fresh rock dust in the area.

Both overburden stripping and phosphate matrix mining are performed with draglines

Planning A Radio System For Profits

Factors Which Made a Radio System in Florida Phosphate Operations Pay Off Are Described in Logical Detail

By J. G. IVY
Engineering Division
International Minerals & Chemical Corp.

IN April 1950, the Federal Communications Commission authorized the International Minerals & Chemical Corp. to construct and operate a radio system at its phosphate mines located in the vicinity of Bartow, Fla. It was not the first radio system. Neither was it large or expensive. The initial installation consisted of a fixed transmitter and 14 mobile units. Our capital investment was only $12,000. Practically all of the radio equipment was of standard design; hence this installation represented no startling advance in the science of electronics.

The question may therefore properly be asked: What aspect of this conventional radio system makes it worthy of further study? What can we learn from this installation?

The reason this radio system is worthy of study is that its performance has shown it to be eminently suited to the task. Our actual experience — now about five years — has proved it to be most successful in accomplishing its real mission of increasing International's earnings by saving money and lowering production costs.

System Described

In Polk County, Fla., centered roughly around the city of Bartow, International has a cluster of three active phosphate strip mines, each with its own concentration plant. These mines are: The Noralyn Operation, the Peace Valley Operation, and the Achan Operation, located five miles, seven miles and 15 miles, respectively, from Bartow.

In addition, there are the drying and grinding facilities at Prairie, about nine miles from Bartow. The facilities have a combined annual capacity of over 3½ million tons of refined phosphate rock. The Noralyn Mine is the largest phosphate operation with concentration plant in the world.

The administration for this multi-million-dollar operation is centralized in air-conditioned offices at Bartow. Likewise, the maintenance repair and supply facilities are centralized in an efficient maintenance center close to the Noralyn Mine.

The mining is accomplished by large draglines which strip the overburden and deposit the phosphate matrix around the periphery of shallow pits, called wells, dug at intervals by bulldozers alongside the main cut. The phosphate matrix is sluiced down into the well with water and the resulting slurry is pumped to the concentrating plant which may be ½ to 3 miles away. Man-sized hydraulic transportation systems employ a series of 600 hp dredge type pumps and 14-in. pipelines. This type of operation allows for a minimum storage of mined phosphate matrix and requires that the mine production be closely coordinated with the concentration plant. Radio communication helps with this coordination.

The plants employ flotation cells and spiral concentrators. A large portion

of the phosphate rock is dried and some is ground before shipment.

Of necessity, the supervisory personnel in the mining and maintenance departments spend much of their time in automobiles driving between the several field locations. Certain staff supervisors, such as the Chief Engineer and the Safety Director, must also spend considerable time away from their desks—and out of reach of telephones. Even the Flotation Supervisor of the three concentrating plants, each equipped with telephone communication, spends 25 percent of his time driving between plants. Without radio, he would be out of touch with the people he supervises for more than two hours per day.

The radio system provides a tool which enables the mining, milling, maintenance and engineering departments to work as a closely coordinated team. Such teamwork is impossible if the members of the team are out of touch with each other the majority of the time.

Consider the opportunity afforded a mining superintendent, who is 30 percent available to a telephone, to talk to a maintenance superintendent who, likewise, is 30 percent available. Statistical mathematics tell us that the odds on completing a phone call between these two men are about 10 to 1 against. With radio, these two men are available perhaps 90 percent of the time, and the odds change to about *4 to 1 in favor* of successful communication.

If three parties are involved, as is frequently the case, the comparison is even more dramatic. Without radio the odds would be about 30 to 1 against, and with radio about 3½ to 1 in favor of successfully establishing communication.

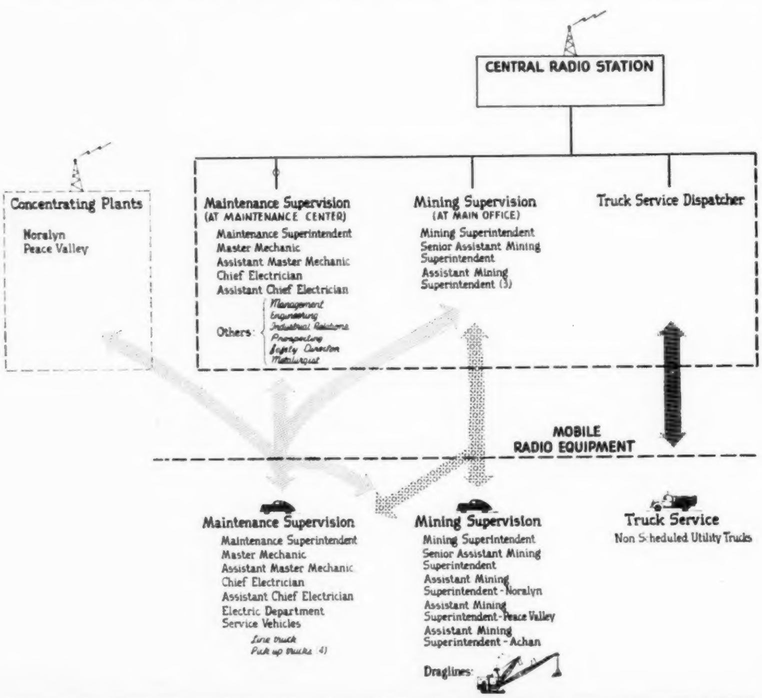
This discussion includes four principles which we found were most important in the successful planning of a radio system. These are:

1. Think communications not electronics.
2. Keep adequate records.
3. Plan for expansion.
4. Recognize your civic responsibilities.

Think Communications Not Electronics

A most important factor in the success of a radio system is the proper allocation of communication facilities to those who need them. Before considering any specific type of radio equipment, it is important to study the relationships of people with each other, and the need for communication to determine which individuals can benefit by radio.

Start with an organization chart—a complete one that goes into the grass roots of your operations. Select an individual who could benefit by the use of radio. Now remember that communication is a two-way interchange of information. It is necessary not only that he had a radio in his vehicle but also that the individuals with whom he must talk have similar radio equipment. Jack Robison, an



A well planned radio system ties in all departments, expediting the jobs of supervision and coordination

Surveyors make profitable use of walkie-talkie units

Assistant Mining Superintendent in charge of the Peace Valley Mine, spends most of his time in the field supervising from his car. He must have direct contact with his operating team. This is provided by means of a radio on the dragline, a centrally located unit which can pass on communications to the matrix handling and bulldozer crews around the matrix wells. Jack must also communicate with the maintenance department to request their services, to schedule their work, and to make emergency reports on breakdowns. This means that our central maintenance shop must be equipped with radio as well as the supervisory maintenance personnel who spend much of their time away from the shop. In addition, Jack must keep in touch with his own supervisors; this means a radio in the central administrative office. Finally, he must talk to the concentration plant to coordinate unscheduled stoppages and resuming operations.

After the Industrial Engineers developed a *plan* for communication, the Electrical Engineers were able to choose equipment which would satisfy the functional needs. Radio was the first step in making our machines servants to the men who run them instead of vice versa.

Note the recommendation to "start with an organization chart that goes down to the grass roots of your operations." Radio is a tactical tool for communications, not a strategic tool. It is natural to start with the most important man in the operation, but in discussing the system with the plant manager, it was a surprise to learn that he felt he had no use for a radio. He directs the efforts of those with whom he works by means of conferences, telephone calls, and memoranda. The proper place for radio communication is between the supervisors in the field and their working teams. In

a properly run organization, it is undesirable for the Plant Manager to bypass the normal chain of command and issue orders directly to the field; hence, it is recommended that the organization chart be studied from the working team *upward* rather than from the Plant Manager downward.

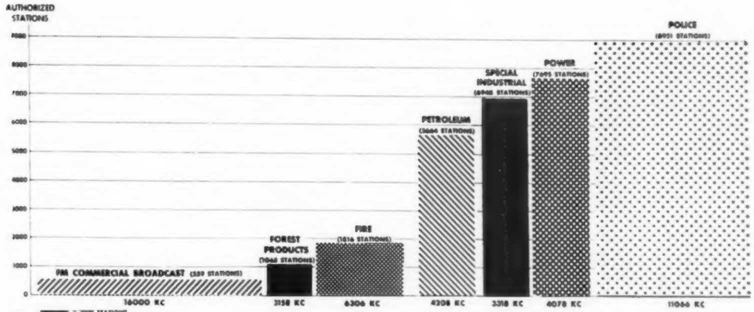
Keep Adequate Records

Modern management requires an accurate and tangible assessment of the profits on its invested capital. Radio systems are no exception. Such an assessment of a radio system is admittedly difficult to pin down. It is impossible to do so without adequate records.

The initial investment in radio equipment must be made to a considerable extent on faith. Without previous experience, it is impossible to assess accurately what savings can be achieved. The best substitute for direct experience is the experience of others. To justify the initial radio installation, study other radio systems with similar operating conditions and obtain an evaluation of their experience.

Assume that you have started operating a new radio system. Based on the experience of others, plus considerable faith, management has allocated the funds to make the installation. Actually, the task of justification has just begun. Management will want continued reports to determine whether the investment is good and whether expanding the radio system is advisable. The keeping of adequate records is an absolute necessity to accurately assess the performance of your system.

Proper choice of the dispatcher in the master control station is the key to adequate operating records. This individual's performance is important to the success of the radio system from an operations standpoint. Equally important, his log of communications should reveal incidents worthy of further investigation to determine what really happened and what it "might have cost" 'without radio. Industrial engineers will want to inspect the operating log to pick out incidents where savings are indicated. They will then want to investigate them further, probably interviewing the individual involved. A dollar value can be assigned to these incidents on the basis of what it would have cost without radio. An analysis of these costs will give the information required to answer Management's question: Is this radio system paying off? Further, it will give you the ammunition to obtain more radio units should experience indicate that they are required.



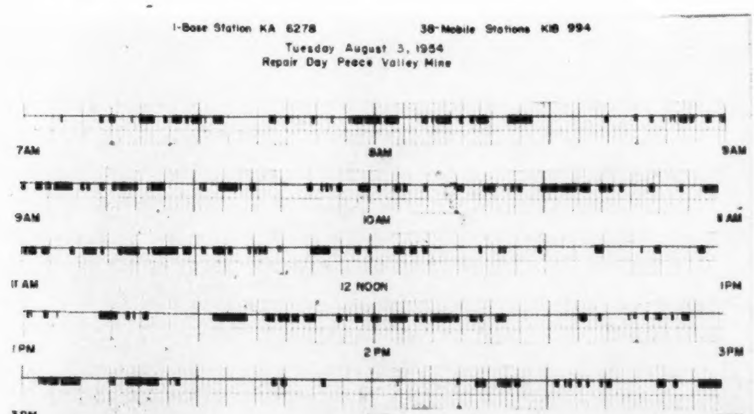
Comparison of use of assigned spectrum space by F M commercial broadcasting service and certain public and industrial service

Plan for Expansion

International's original radio system consisted of one central transmitter and 14 mobile receivers. Today, five years later, we have 35 mobile units in operation. We actually operate several systems on two radio frequencies. The first frequency, our long range system, ties together primarily our maintenance, mining, milling and staff departments. In addition, we operate four spot networks on a second frequency in the low power radio band to serve the needs of small working teams in the field.

At the drying and grinding operation, the phosphate rock is brought in on railroad cars and dumped from an overhead trestle according to grade. To provide additional storage, bulldozers move this rock out from under the trestle and extend the storage pile for a considerable distance beyond the natural angle of repose of the rock. These same bulldozers also push the rock back beneath the pile so it may be drawn off by an underground conveyor located in a tunnel below the pile. A supervisor, located within view of the tractors and the switching locomotives, coordinates the movements of both of these units and greatly increases the efficiency of the operation. In this instance, radio has saved the cost of one bulldozer and operator, approximately $10/hr. It does not take long to pay for radio communication on this basis.

This is a splendid example of a spot network in which the communication distances are small and there is little need for long range communication. Indeed, this system would be hampered by all of the communication on the mining and maintenance department system. We have other spot communication networks between our draglines and the matrix pumps. Walkie-Talkie units have proven to be a useful tool for surveying parties and in construction work.



This type of radio log shows time the radio is in use. A written log summarizing the communications is even more important

Civic Responsibilities

By recent count there were 6948 radio stations operating in the so-called "Special Industrial Band." A majority of these use the five frequency channels around 150 megacycles which are better suited to their short range communication needs (up to 30 miles) than are the lower frequencies between 25 and 50 megacycles. These five so-called "special industrial" frequencies are shared by nine classes of users:

1. Farmers and Ranchers.
2. Heavy Construction—such as building highways, bridges, railroads and sewers.
3. Building Construction—general contractors not in Class 2.
4. Manufacturers—such as steel

The dragline operator has radio phone at his left elbow

mill, automotive and aeronautical plants, shipyards.

5. Specialized Trade Activities—crop dusting, oil well service, right of way clearing and maintenance for public utilities.
6. General Service Activities — repair of heavy machinery, delivery of ready mixed concrete.
7. Engineering Service—geophysical and geological surveys.
8. Miscellaneous Public Service Activities—servicing of heating and refrigeration equipment.
9. Mining and Ore Beneficiation.

Tuning in to these frequencies in certain parts of our country reminds one of the Tower of Babel.

In contrast the following groups of users have frequency allocations for their own use:

Petroleum—9 channels.
Railroads—39 channels.
Forestry—9 channels, shared with petroleum.
Public Utilities, such as electricity and gas—9 channels.
Motion Pictures—7 channels.

All of these services are important to industry, commerce and the public welfare and need radio communication. Yet by comparison, I feel that the mining industry is in a class with the "forgotten man."

Fortunately, there are two solutions to this problem of inadequate frequency allocation to the mining industry. All either solution requires is recognition from the Federal Communications Commission that the mining industry *is* important. Both solutions allow the present users of radio to continue their use besides allowing them room for expansion.

In February 1955, the National Association of Manufacturers' Committee on Radio Use petitioned the FCC to allocate a portion of the radio spectrum around 90 megacycles for industrial use. The proposal was principally for the benefit of the manufacturers, but there is room for the miners too, since mines are generally not located in areas of intensive manufacturing.

This part of the radio spectrum is presently allocated to FM Broadcasting but is only lightly used. There is room for approximately 700 industrial channels plus all the existing FM Broadcast stations plus an allowance for expansion in FM Broadcasting. Presumably because of economic considerations, the number of FM Broadcast stations has not increased. On the contrary, there are 25 percent fewer stations in operation now than there were five years ago. In contrast, the number of stations now crowded into the special industrial band has *increased 800 percent* in the same five years.

This petition is currently under consideration by the FCC in Washington.

Another solution to the problem of frequency shortage lies in geographical assignment of frequency blocs. At present, to simplify administration, the FCC makes frequency allocations on a nationwide basis, but this is wasteful.

Perhaps the railroads need 39 frequencies in Chicago where there are 35 railroads. But how many railroads serve *your* community? Some of these 39 frequencies could be used by others, and still leave ample space in the radio spectrum for the railroads.

There is much petroleum activity in Texas and the Southwest. But how much petroleum activity is there near you? Much of our country simply does not have the trees to support an extensive forestry industry. These idle petroleum and forestry frequencies could be allocated to others without the slightest harm or inconvenience to these industries.

The mining industry needs your help in obtaining sufficient frequency allocations. The N. A. M.'s Committee for Radio Use is working on the problem and merits your support. Writing your Congressman would help. If radio is to continue as a useful tool of the mining industry, this challenge must be met.

The dragline is the communication center for the mining area

Mineral Content, a Factor in Weathering of Mine Roof

A Résumé by the Committee on Roof Action of Geologic Studies Outlining the Chemical Composition of Typical Mine Roof Rocks and the Relationship Between Composition and Mine Roof Strength

By CHARLES T. HOLLAND

WEATHERING of mine roof refers to those changes that occur in the rock due to contact with the mine atmosphere or in some cases to the changes caused by the combined action of ground water and the mine atmosphere. Insofar as the atmosphere is concerned, important factors in the alteration in the roof are changes in temperature, changes in moisture, and the presence of oxygen and carbon dioxide. Concerning the rocks, the important aspects are their porosity, permeability, and mineral composition. Two aspects of mineral composition are important: (1) The actual minerals present and their properties; (2) The amount of each mineral present.

In a previous report by Price and Headlee, the minerals and other materials likely to be present in mine roof rock were listed essentially as in table I. Since it seems probable that the properties of mine roof as related to weathering and even strength will be determined to some extent by the actual concentration of the minerals or materials listed in table I, the attempt has been made to assemble material on the percentage mineral composition of mine roof.

Mineral Composition of Roof Shales

The mineral composition of some 18 samples of shales on 11 coal beds in southwest Virginia and southern West Virginia has been studied by Meyertons (1956). The shales were all Pennsylvanian in age and ranged from near the base of the Pocahontas to near the top of the Kanawha of the Pottsville group. An abstract of the results obtained is shown in tables II, III, IV, and V.

These results are of interest in that they not only give the mineral content but also show considerable variation in mineral content of roof shales. The clay fraction of the roof shales studied consists essentially of two minerals, illite and kaolinite; the illite being the larger component. Also of considerable interest is the absence of montmorillonite in detectable quantities in any of the shales.

That considerable variation in mineral content can occur in the roof rocks of the same mine is shown by the minerals in table IV. It will be noted that the portal sample is much lower in organic material than the sample taken well underground. The largest difference being in organic material, it seems reasonable that the difference is caused in part, at least, either by oxidation or by dilution of the material near the portal.

TABLE I

Minerals and Other Material Likely to be Present in Mine Roof Rocks

1. Clay minerals
   - A. Kaolin Group
     - (a) Kaolinite—$2H_2O.Al_2O_3.2SiO_2$.
     - (b) Halloysite—$Al_2O_3.2SiO_2.nH_2O$.
   - B. Montmorillonite Group.
     - (a) Montmorillonite—$Al_2O_3.5SiO_2(Ca,Mg)O.nH_2O$.
     - (b) Beidellite — $Al_2O_3.3SiO_2.nH_2O$.(?)
     - (c) Nontronite—$Fe_2O_3.3SiO_2.nH_2O$.
   - C. Illite Group—$(OH)_4K_y(Si_{8-y}.Al_y)(Al_4.Fe_4.Mg_4.Mg_6)O_{20}$ y less than 2 frequently equal to 1 to 1.5.
   - D. Mixed Layer Group
     - (a) Montmorillonite-Illite
2. Mica—muscovite—$K_2O.3Al_2O_3.6SiO_2.2H_2O$.
3. Quartz—SiO_2.
4. Siderite—$FeCO_3$.
5. Calcite—$CaCO_3$.
6. Pyrite—FeS_2.
7. Feldspar—$K_2O.Al_2O_3.6SiO_2$.
8. Chlorite—$5(Mg,Fe)O.Al_2O_3.3SiO_2.4H_2O$.
9. Coal and other organic material.
10. Uncombined water.

TABLE II

ESTIMATED MINERAL COMPOSITION OF ROOF SHALES (OPTICAL METHODS)
(Abstracted from Meyertons, 1956)

Mineral	Mica	Chlorite	Clay	Quartz	Feldspar	Organic Matter
Minimum Percentage	5	1	5	5	Very low	3
Maximum Percentage	60	20	40	30	45	33
Average Percentage*	27	5	22	14	20	13

TABLE III

ESTIMATED PERCENTAGE OF MINERALS PRESENT IN THE—2m (CLAY) SIZE FROM DIFFERENTIAL THERMAL CURVES)**
(Abstracted from Meyertons, 1956)

Mineral	Kaolinite	Illite	Chlorite	Organic Matter
Maximum Percentage	47	70	20	10
Minimum Percentage	25	50	Very low	2
Average Percentage*	37	56	1±	7

*These columns add up to 101 percent because decimals are rounded to the nearest whole number.
**m=0.001 mm.

TABLE IV

VARIATION IN COMPOSITION OF ROOF SHALES
(Abstracted from Meyertons, 1956)

Location of Sample	Mica	Chlorite	Clay	Quartz	Feldspar	Organic
Inside Mine	35	2	5	3	10	45
At Portal	60	2	20	5	10	8

In addition to the above minerals, the investigation indicated the presence of the following soluble minerals in the shales: Halite (NaCl), chloromagnesite ($MgCl_2$), thenardite ($NaSO_4$) and several forms of $MgSO_4$ (the anhydrite, the hexahydrite and the tetrahydrite). The magnesium, sodium, chloride and sulphate material extracted from the shales are indicated in table V. These results are of interest because $NaSO_4$ and $MgSO_4$ are efflorescent minerals and through this property may contribute to the failure of roof rocks in mines.

A rather detailed study (Holland 1948) has been made of the shales forming the roof of 14 coal beds in West Virginia. These beds were all of Pennsylvanian age and extended from near the base of the Pottsville to the middle of the Monongahela. In all, some 37 samples of the immediate roof rocks were taken. Chemical analyses of these make available the data shown in tables VI, VIII, and figure 1. It will be noted from these tables that in some roof shales rather heavy concentrations of iron sulfide and carbonate minerals exist. Not shown in the table but indicated by the results of the analyses is that, generally when the carbonate concentrations are high, the iron sulfide concentrations are low. Also, in many of the shales the ignition loss was high, indicating in general a rather high organic matter content. And as table VIII shows, considerable variation exists in the material making up the roof rocks. It is also true, as shown in figure 1, that at a given location, considerable variation exists between the several strata making up the immediate mine roof.

Grim and others (1935) have investigated the composition of 18 shales (involving 59 samples) of Pennsylvanian age lying above coal in Illinois. Of these 18 shales, eight (involving 44 samples) are described as "overlying coal beds." Several of these unquestionably formed the overshales of coal beds. The samples taken, however, were from throughout the bed rather than from that part of the shale in immediate contact with the coal bed as were those of Meyertons and the samples studied in West Virginia. These studies revealed that the clay (-2μ) fraction of these shales consisted principally of illite and kaolinite with minor amounts of chloritic mica, quartz, limonite and organic material (Grim 1941, p. 27). Illite

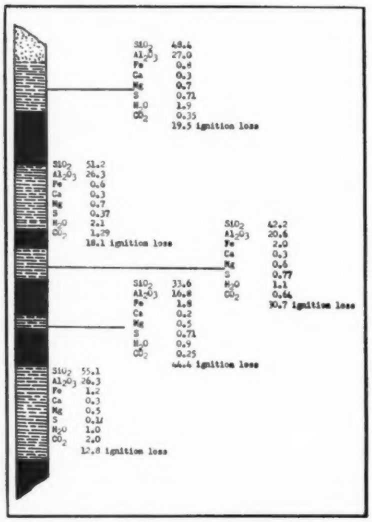


Fig. 1. Variation in composition of different strata of Pittsburgh roof shale at a particular location

was found to be much more abundant than kaolinite. In only one of the shales (this one from over the Frances Cree shale and Coal No. 2) was montmorillonite detected (Grim, 1941, p. 27). The $+2\mu$ portion of the shales is made up essentially as shown in table VII. This fraction ranged from almost nothing in some shales to 60 percent and more in shaly sandstones or siltstones, and most commonly, it comprised about 25 percent of the sample (Grim, 1935).

Murray (1953) has also studied the Pennsylvania shales of Illinois and Indiana. The shales studied were located in several different formations and cyclothems. Several of these shales (those in the shallow marine or brackish water deposits) probably formed the roof shales on coal beds. These studies indicated, as did those of Grim, that illite was the most abundant mineral in the shales followed by kaolinite, with chlorite the least abundant. The brackish water deposits were found to have less illite and more kaolinite than the open marine deposits higher in the cyclothem and further removed from the coal beds. In none of the samples studied (26 in all) was montmorillonite detected (Murray 1953, p 59).

In view of the data cited above and other information, table IX has been constructed to show the minerals commonly to be expected in roof shales on coal beds of Pennsylvania age in the area studied, namely, West Virginia, Illinois, Indiana and Virginia. Also shown in the table is a first approximation of the limits of the concentration in which these minerals may be expected to be present. Further investigation probably will change the concentration limits, perhaps by a considerable amount.

TABLE V

SOLUBLE SALT CONTENT EXTRACTED FROM SHALES BY LEACHING WITH DISTILLED WATER
(Abstracted from Meyertons, 1956)

Ion	Na^+	Mg^{2+}	SO_4^{2-}	Cl^-
Maximum Percentage	0.0776	0.0325	2.430	0.310
Minimum Percentage	0.0020	0.0003	0.074	0.002
Average Percentage	0.0177	0.0053	0.513	0.074

TABLE VI

SOME MINERALS IN MINE ROOF ROCKS OVER WEST VIRGINIA COAL BEDS

Material	Pyritic Sulfur**		Carbon Dioxide			Ignition Loss
	As Pyritic Sulfur	As Pyrite or Marcasite	As CO^2	As Carbonates		
				Calcite	Siderite	
Maximum Percentage	5.5	10.2	3.70	8.4	9.8	44.44*
Minimum Percentage	0.04	0.1	0.00	0.0	0.0	6.4
Average Percentage	0.92	1.7	0.79	1.8	2.1	15.1*

* Largely organic material but includes some water of crystallization and in some cases carbon dioxide.
** Nitric acid soluble sulphur.

TABLE VII

COMPOSITION OF THE +2m FRACTION OF PENNSYLVANIAN SHALES LYING ABOVE COAL BEDS IN ILLINOIS
(Abstracted from Grim, 1935)

Quartz, usually > 80%
Muscovite flakes < 1% to < 15%
Chloritic material < 5%

Feldspar < 1%, Pyrite biotite, Calcite, siderite — Present, but percentage limits are not available.

Zircon, tourmaline, apatite, epidote, rutils, garnet, hornblende, anatase, brookite, glauconite, corundum, staurolite, gypsum and sillimanite — 1%

Properties of Minerals in Shales of Importance in Weathering of Mine Roof

Ion Exchange. Ions, both positive and negative, may be held in an exchangeable state by clay minerals. Both anions and cations can be absorbed and exchanged, but at present most information available pertains to the exchange of cations. Generally the exchange occurs in a water solution, but sometimes it may occur in a non-aqueous environment (Grim 1953, p 142). The cations usually held in an exchangeable state are Ca^{++}, Mg^{++}, H^{+}, K^{+}, NH_4^{+} and Na^{+}, with Ca^{++} usually being the most abundant and Na^{+} usually the least abundant. In general, kaolinite has the lowest exchange capacity and montmorillonite the greatest, with illite, chlorite and halloysite falling in between (Grim 1953, p 159). The exchangeable cation influences many properties of a clay mineral, as well as the extent by which its properties may be altered when its environment is changed, sometimes very slightly. Also, inorganic cations, under the right conditions, can be exchanged for organic cations. Some organic cations, when exchanged for inorganic ones, make the clay minerals less sensitive to water. Such a change reduces the clay's plasticity, shrinkage and slaking attendant to change in moisture content (Davidson 1949, p 535-536).

Materials such as rock dust, deliquescent salts, and paints may also carry exchangeable ions. Therefore, some rather common mining practices such as rock dusting, spraying or painting may result in change of properties of roof and floor rock. Whether these operations will cause a beneficial or harmful change will depend upon the type of exchangeable ion in the roof and the material being applied.

Water Exchange. All coal bed roof shales contain water. For purposes of this discussion, this water can be divided into two types: (1) Water that is exchanged with the mine atmosphere with changes in relative humidity of the mine atmosphere at mine temperatures. (2) Water that is not so affected and, consequently, is not of interest in this study. Water of Type 1 probably includes water from the following sources: (a) Water as free liquid in the pores of the shales, around the edges and on the surface of the particles making up the shale—this water is freely exchanged with the mine atmosphere as its relative humidity varies. (b) Water that may be roughly classified as interlayer water and which consists of water between the unit layers of certain clay minerals such as montmorillonite or hydrated halloysite or within the tubular openings between elongate structural units of other clay minerals—this is the water that causes most of the volume change of montmorillonite with changes in degree of hydration. Some of this water (type b), but not all, also is freely exchangeable with the mine atmosphere with changes in its relative humidity. (c) Water of crystallization of other minerals—some of this also may be exchanged with the mine atmosphere. It seems likely that this Type I water largely controls plastic effects, expansion or contraction, and slaking effects of roof shales. Each of these properties will be discussed briefly, and as these effects will be determined largely by the clay minerals present, each will be discussed from this point of view.

Plasticity. The important elements in plasticity of the clay minerals are: The type, the particle size, and the geometric features of the mineral present and the kind of exchangeable cation present. Kaolinite exhibits less plasticity than montmorillonite, with illite and chlorite falling in between. Halloysite may or may not develop highly plastic properties, depending upon its state of hydration; halloysite apparently is most plastic when only partly hydrated. Particle size influences the plasticity of kaolinite, illite, and chlorite; their plasticity, particularly that of illite, increases with decreasing particle size (White 1949, p 511, and 1954, p 37). The plasticity of montmorillonite, in addition to particle size, is greatly influenced by the kind of exchangeable cation it carries. A sodium or lithium exchangeable cation greatly increases its plasticity while calcium or magnesium in the exchange position causes montmorillonite to show less increase in plasticity (White 1954, p 37). The plasticity of kaolinite, illite, and chlorite is affected much less by the kind of exchangeable cation present. Clays have the ability to absorb considerable water before plastic effects develop, then with the addition of just a little more water, a rather abrupt change in plasticity usually occurs (Grim 1950, p. 6). Consequently, when mine air is depositing waters on the mine roof, the plastic effects of the clay minerals in the shales may develop quite abruptly. Along this line, it also has been found that when certain organic cations replace certain inorganic ones, the plasticity of some clay minerals is reduced.

Expansion and Shrinkage of roof shales with moisture changes are believed to be two of the more destructive weathering effects. The change in volume of roof shales with change in water content is dependent upon a number of factors such as kinds and amount of clay minerals present, the exchangeable ions, the particle size of the minerals, voids, internal structure of the shale, and nature and magnitude of confining stresses. In expansion, two mechanisms are involved: (1) A relaxation of effective compressive stress related to enlargement of capillary films, and, (2) osmotic imbibition of water by expanding lattice clays. In shrinkage, the same factors

TABLE VIII

CHEMICAL ANALYSES OF SHALES OVERLYING COAL BEDS

Compound	West Virgin a Coal Mine Roof Shales (Holland, 1948) Percentage	Illinois-Indiana Shales Brackish Deposits (Murray 1953, p 55) Percentage
SiO_2	33.6-60.1	44.7-65.1
Al_2O_3	15.6-27.6	14.8-20.4
Fe_2O_3	0.8-11.1	5.3- 9.2
MgO	0.5- 2.4	1.0- 2.2
CaO	0.0- 0.7	0.3- 2.8
Na_2O	1.6- 4.7	0.1- 1.3
K_2O	Total Alkali	2.2- 3.3
TiO_2		0.6- 1.0
Ignition Loss	8.4-44.4	6.1-16.4
CO_2	0.3- 3.7	No Information
H_2O	1.55-4.7	No Information
SiO_2/Al_2O_3	1.80-3.1	2.2- 4.1
Sul.	0.05-6.0	No Information

TABLE IX

MINERALS PRESENT IN SHALE IMMEDIATELY ABOVE COAL BEDS AND APPROXIMATE LIMITS IN CONCENTRATIONS OF THE MINERAL

Mineral	Approximate Limit Percentages	Mineral	Approximate Limit Percentages
Clay	5 to 75	Siderite	0 to 12
Kaolinite	2 to 30	Calcite	0 to 15
Chlorite	0 to 15	Iron Sulfide	0.1 to 12
Illite	3 to 60	Feldspar	0 to 45
Montmorillonite	0 to 10	Chlorite	1 to 20
Mica	5 to 60	Coal & Other Organic Matter	3 to 50
		Uncombined Water	1 to ?
Quartz	5 to 35	Soluble Salts	0.05 to 3.0

are active except the action is reversed (Mielenz and King, 1955, p. 230 and 235). The changes in volume of kaolinite, chlorite, and illite seem to be controlled largely by the first mechanism while the changes in volume of montmorillonite are closely related to the second. Shales usually expand when water is adsorbed and contract when water is given up; those containing appreciable quantities of montmorillonite generally show the greatest volume changes. Furthermore, the amount of change is dependent upon the type of exchangeable cation. In a given shale, montmorillonite is likely to have an expansion and contraction effect considerably greater than its concentration in the shale would indicate. The actual amount of volume change in a shale caused by a change in hydration is probably reduced by the material, other than the clay mineral composing the fabric of the shale. Actual tests, however, indicate that coal mine roof shales show considerable expansion and contraction corresponding to increase or decrease of water content (Landsberg, 1938, p. 365, Hartmann and Greenwald 1941, p. 22-29). Laboratory results indicate that expansion of clays such as montmorillonite may be controlled by use of certain chemicals such as water soluble cationic amine acetate (Davidson 1949). Favorable results have been obtained also in the case of kaolinite soil by use of a fatty acid amine acetate (Davidson and Glab 1949).

Slaking also occurs in shales with change of water content. It, too, is a very important effect produced by the weathering effects of the mine atmosphere. The mechanism of slaking seems to be somewhat as follows: (Mielenz and King 1953, p. 240): (1) During drying, the shales shrink and differential stresses are set up which cause cracks in the shale. (2) As the water evaporates from the shales, it is replaced by air. (3) When water is readsorbed by the shale, the air is entrapped and compressed in capillary openings and cause tensile stresses in the shale. (4) Also, as the shales adsorb water, particularly if they contain expanding clay minerals, differential stresses are set up in the shale. (5) The stresses caused by the entrapped air and expanding minerals, if present, act to cause the clay to slake. Another factor may be the weakening during hydration and dehydration of the electrostatic forces between the shale particles. A further factor in slaking may be the property of efflorescence of certain soluble salts when they are present in the shales. Consequently, shales having strongly expanding clay minerals, such as montmorillonite, would be expected to show the greatest tendency toward slaking. Shales consisting of kaolinite, illite and chlorite would be expected to slake somewhat less rapidly. Remedial action suggested is to apply a protective cover as soon after the shale is exposed to the atmosphere as possible (Holland 1954). Slaking is also reduced by electrochemical or electroosmotic treatment (Mielenz and King 1953, p. 241) or by introducing organic cations which cause the clay to exchange water with the atmosphere less avidly.

(a) Weathering and join ing have combined to produce a dangerous piece of roof rock. The prop is well placed. The rock is a sandy shale. Note that the weathering tends to produce spherical shapes approaching somewhat the spheroids produced in massive rock

(b) Weathering at a joint plane. Note the immediate roof shales have not been visibly affected. The immediate roof is a shale. The rock overlying is a shaly sandstone

Fig. 2—Roof shales on the Raven (Lower Douglas) bed in Tazewell County, Va. The white mark in the picture is approximately 12 in. long

Some Chemical Alterations Caused by Weathering

The analyses of the West Virginia roof shales indicate that all coal bed roof shales contain from small to large amounts of iron sulfides. These sulfides, in the presence of moisture and oxygen, oxidize to form $FeSO_4$ and sulfuric acid (Burke and Downs 1938). The ferrous sulfate can take on water of crystallization and occupy several

times the volume of the original iron sulfide. This increased volume is certain to cause high local stress areas and possibly failure of the roof rock. The sulfuric acid in addition may react with the feldspar, carbonates, and certain of the clay minerals present, thereby further weakening the roof, and by forming new compounds, some of which hydrate and expand, thereby forming additional high stress areas. For example, when calcium carbonate is present, anhydrite ($CaSO_4$) is formed which hydrates to gypsum. Other minerals present which can be oxidized are siderite, invloving a shrinkage in volume of 27.5 percent (Clarke 1924, p. 544), organic material involving a shrinkage in volume, and ferrous iron in some of the silicates present; oxidation effects in general will act to decrease the strength of mine roof. Oxidation effects, however, are usually not manifested until the roof has been exposed to the mine atmosphere for a period of a few months.

Carbon dioxide (present in rather heavy concentrations in some areas of coal mines) dissolved in ground water may attack the feldspar present as well as some of the micas, thereby causing roof rock changes and possibly damage, although in mine roof this damage is probably secondary to that caused by oxygen.

Some effects of exposure of shales to different saturated atmospheres are shown in figure 3 (Holland 1948, p. 165). The shales tested were from over the Pittsburgh coal, and contained appreciable quantities of iron sulfides. It will be noted that the shales kept in a helium atmosphere show no damage, but those kept in an oxygen atmosphere were badly damaged. The shales kept in an atmosphere of carbon dioxide were damaged, but not so much as those kept in oxygen.

A. After exposure of 6½ months to helium

B. After exposure of 6½ months to oxygen

C. After exposure of 7½ months to CO_2

Fig. 3.—Effects of various atmospheres saturated with water vapor and held at constant temperature upon Pittsburgh Coal roof shales

Minerals Associated with Shales Forming Good and Bad Roof in Mines

Observations by the Illinois Geological Survey indicate that kaolinite and crystalline illite and chlorite are associated with shale forming good mine roof. Shales containing montmorillonite and expanding random mixed lattice minerals usually form unsatisfactory roof (White 1954). Also, shales in which sand size particles predominate were observed to be associated with good roof by Meyertons (1956), but when silt size particles were dominant, the roof shales were usually reported to be unsatisfactory. It also seems to be true that roof shales often are unsatisfactory if they contain more than a few tenths of a percent of iron sulfide. On the application of this information, however, it should be remembered that mineral content is only one factor among several factors which together determine whether a mine roof will be satisfactory.

Conclusions

1. Mineralogic studies of some 38 shales in southwest Virginia and Illinois and Indiana overlying coal beds in Pennsylvanian rocks disclosed only one shale with detectable amounts of montmorillonite. This would seem to indicate that shales forming the roofs of Pennsylvanian coals rather rarely contain detectable quantities of this mineral.

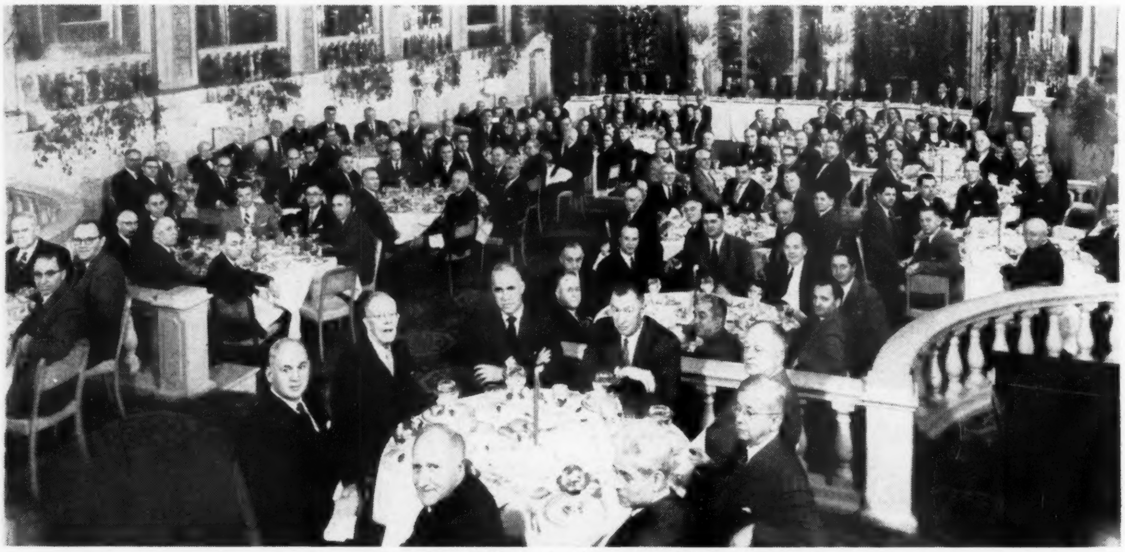
2. Studies of roof shales in West Virginia indicate that many shales contain appreciable quantities of iron sulfide and perhaps of siderite. Both of these minerals are oxidized in the presence of moisture ond oxygen.

3. The information cited above indicates that the clay content of roof shales varies between about 5 percent and 75 percent. The principal minerals usually present in roof shale clays are illite and kaolinite, the illite being the larger component.

4. Roof shales may contain appreciable quantities of soluble salts. Some of these effloresce and by this property may contribute to roof failure.

5. Materials subject to oxidation in mine roof are iron sulfides, siderite, ferrous iron in certain micas and organic material.

(Continued on page 67)



Over 200 mining industry leaders attended the banquet

Mining Congress Annual Meeting

Sen. Harry Byrd Commends the Policies of the Mining Industry and Supports His Stand on the Need for a Balanced Budget

REPRESENTATIVES of coal mining, metal mining and industrial minerals industries and mining manufacturers assembled in New York on December 5 for the annual business meeting, marking the 57th Anniversary of the founding of the American Mining Congress.

Presiding over the program at the annual dinner was AMC President Howard I. Young, who expressed his gratitude to the members as a whole for their loyal support and to all committees for their untiring efforts in behalf of the industry.

Julian Conover, executive vice-president, gave a short report on the work of the American Mining Congress. He cited various activities of the organization and referred particularly to the work in connection with legislation and operations of the various Federal Departments and agencies. He called attention to developments in taxes, labor laws, revision of mining laws, the highway program, renewal of the Trade Agreements Act, extension of the Defense Production Act with its provisions for mineral exploration and purchase programs, contract renegotiation, water and air pollution, silver, gold, uranium mining, social security, the heavy imports of residual fuel oil, mine safety, S. E. C. regulations, Government reorganization, mobilization plans, stockpiling, coal exports, freight rates, the mineral census, and a host of other matters involving constant contact with the Federal agencies and the industry.

During the course of his remarks Conover alluded to the attack made upon Mr. Young in a General Accounting Office report and to Mr. Young's appearance before a Congressional Joint Committee and his forthright vindication of his record as a government official. Following this reference, the membership gave Mr. Young a rising vote of confidence accompanied by prolonged applause.

The financial position of the American Mining Congress was reported on by Andrew Fletcher, chairman of the Finance Committee. His statement showed a balanced budget and a steady growth in membership.

C. Jay Parkinson, chairman of the nominating committee presented nominations for directors which included: for a one-year term, W. A. Wecker; for a two-year term, E. G. Fox; and for a three-year term, R. E. Dwyer, L. R. Kelce, D. S. MacBride, F. S. Mulock, C. J. Potter, M. E. Shoup, H. S. Taylor, J. E. M. Wilson and H. I. Young. Their election was unanimous. All officers were reelected for 1956. These include H. I. Young, president; Worthen Bradley, Andrew Fletcher, and R. E. Salvati, vice-presidents, and Julian Conover, executive vice-president and secretary.

The guest speaker was the Honorable Harry F. Byrd, United States Senator from Virginia and Chairman of the Senate Committee on Finance. A veteran of more than 22 years' Senate service, he gave a thought-provoking talk on Government policies in the fields of fiscal affairs, taxation, and tariffs and trade.

Byrd emphasized the importance of attaining a balanced Federal budget and making a start on reduction of the nearly $300 billion Federal debt before making reductions in taxes. He commended the American Mining Congress for its Declaration of Policy calling for reductions in Federal expenditures, and for assisting the Senate Finance Committee to understand the problems of the mining industry.

The Senator said he favors a trade agreements program with other countries, but "we must keep it reciprocal." He pointed out that the United States has reduced its tariffs by 70 percent since adoption of the trade agreements program in 1935. But, he asked, "what have other countries done during the same period?" Byrd

(Continued on page 71)

Operators Corner

NPSH – NET POSITIVE SUCTION HEAD (Above Vapor Pressure)

By Following These Few Simple Steps You Can Also Make It Mean "No Problem with Suction Here" When Using Centrifugal Pumps

By J. A. CABLE
Application Engineer
Norwood Works
Allis-Chalmers Manufacturing Co.

IF you are only concerned with pumping water out of an open tank at sea level and at temperature less than 85° F, you don't have to read any further. You can think in terms of suction lift and let it go at that. However, once any of these factors change, NPSH is the only right way to summarize pump suction conditions.

There are two kinds of NPSH—first, that which the pump user has available and secondly, that which a particular pump will require. By proper comparison of the two, any solvable pumping problem can be properly fitted with a centrifugal pump.

At sea level, atmospheric pressure can be said to "serve a helping of 34 ft of NPSH." All that remains is to be sure that there is enough to go around for all of the factors to be "waited on" in an application. The factors to be satisfied are:

(1) Reduction in atmospheric pressure if the installation is much above sea level.

(2) Vapor pressure of the product pumped at the pumping temperature.

(3) Suction lift and friction in suction pipe line. Add the static suction lift plus all friction losses in the pipe and fittings. (On any lift application there will be a foot valve as centrifugal pumps have to start full of liquid to be primed or you will not be able to lift anything at all. Be sure to figure in the friction drop through this foot valve.)

At this stage you tell the prospective pump supplier how much there is left as "available NPSH" and all he has to do is pick out a pump that requires less than you have available.

How It Works

A mine near Flagstaff, Ariz., wants to pump 180° F water out of an open heated tank that is above the pump installation point by two ft. Looks easy, but let's see.

Flagstaff is about 7000 ft above sea level so the atmospheric pressure is less than sea level by about 3.5 lb or eight ft. Accordingly we start out with 34 ft less eight ft for pressure loss or 26 net ft of pressure provided by the atmosphere.

Next take this 26 ft and apply the second point mentioned above. You can get vapor pressure of 180° F water out of tables or curves from many sources. It is approximately 7½ lb or 17 ft and we then have 26 net ft of pressure less 17 ft to compensate for the vapor pressure leaving nine ft.

In this example there is two ft of positive head on the suction but this must be modified to suit friction losses in the suction pipe. So now we have: nine ft plus two ft of positive head minus friction (let's assume one ft), ending up with 10 ft available NPSH.

This example was relatively simple, but we ended up with an application where the pump must require less than 10 ft of NPSH to do the job. It is apparent that each of these factors bears looking into.

Formula and Factors

$$NPSH = \frac{2.31\ (P_a - P_v)}{SP.\ GR.} + H_e - H_f$$

where, at the maximum possible pumping temperatures:

P_a = Atmospheric pressure in psia.

This is 14.7 lb at sea level or 34 ft but comes down about 1.1 ft for each 1000 ft above sea level.

P_v = Vapor pressure in psia.

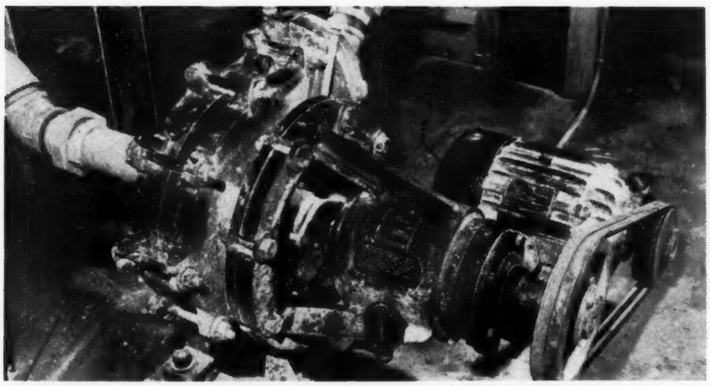
SP. GR. = Specific gravity.

H_e = Elevation head. When water level is above pump, this is a plus figure; if water is lifted to pump, this is a minus figure.

H_f = Friction head or friction loss in suction piping.

If the suction tank is enclosed, such as is the case with a vacuum vessel or evaporator, you usually have the liquid boiling at its surface; in which case $P_a = P_v$. The complete first term of our formula then becomes zero, so available NPSH then equals just $H_e - H_f$.

From this discussion you can figure your own available NPSH or see the importance of furnishing your supplier with correct data so that he can do so.



Before a pump can do useful work several calculable demands have to be satisfied

HARLLEE BRANCH, JR. *Portrait by Fabian Bachrach*

"We consider it a privilege to make the Payroll Savings Plan available to all our people"

As President of Georgia Power Company, Mr. Harllee Branch, Jr., can be proud of his company's Payroll Savings Plan—more than 50% of Georgia Power's employees are Payroll Savers. They are putting more than $423,000 into U.S. Savings Bonds each year. But, Mr. Branch's interest goes beyond his own company Plan. A few months ago, as President of the Edison Electric Institute, he asked all the 185 member companies in the electric utility industry to join in an industry-wide effort to increase employee percentages in their Payroll Savings Plans.

First results of the industry campaign are now coming in. Gulf Power Company has reached 87.3% employee participation...Utah Power and Light employees have enrolled 69.6% . . . Wisconsin Electric Power reports 69.8% . . . Wisconsin-Michigan Power Company, 62% . . . Wisconsin Public Service, 57.6% . . . Lake Superior District Power, 52%.

Has every employee in *your* company been offered an opportunity to enroll in the Payroll Savings Plan? If not, communicate with Savings Bond Division, U.S. Treasury Department, Washington, D. C. Your State Sales Director will show you how easy it is to conduct a person-to-person canvass.

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Mining Congress Journal

1956 Coal Convention

Cincinnati, Ohio, May 7-9

ANOTHER outstanding American Mining Congress Coal Convention will be held at the Netherland Plaza Hotel in Cincinnati, May 7-9. Plans for the convention, which holds the interest of the entire mining industry, are well under way and it promises to be one of the most interesting and constructive meetings that the coal industry has ever held.

The upsurge in coal production last year and the increased optimism of the industry were reflected in the hundreds of suggestions for subjects to be discussed at the convention. More production men are taking a closer look at continuous mining and its auxiliary operations. New tools and techniques are being introduced rapidly. Maintenance is growing in relative importance and is attracting more attention. With the introduction of a 60-cu yd shovel, strip mining has taken another big step forward. Fine coal cleaning and sludge recovery continue to be of prime interest in coal preparation. These are but a few of the many themes with which the Program Committee had to work in designing the program for the 1956 Coal Convention.

Realizing the tremendous impact that future market possibilities hold for coal, the committee has persuaded a leading industry spokesman to take a look at the next few years to see what their effect on the industry will be. In addition, the top official of a prominent coal hauling railroad will discuss the tie between railroads and coal. Atomic energy and how its development will affect coal mining will be discussed at a luncheon meeting by a man well versed in the subject. The program has thus been balanced with talks dealing with the future and the present, the practical and the theoretical, the special and the general.

The social aspect of the convention, an important "change of pace" from preoccupation with more technical matter, has also received full attention. In addition to the luncheon speaker on atomic power, a second luncheon will feature a well-known sports columnist who will give the "low-down" on some of the year's sports highlights. The famous Coal Miners party will be held Monday evening, Tuesday will be "Baseball Night," and the traditional Annual Banquet on Wednesday will provide a fitting climax to the AMC 1956 Coal Convention.

Make your plans now to attend! Hotel reservations may be made directly with any of Cincinnati's famous hotels. A record attendance is expected and it is advisable to write or wire for accommodations as soon as possible.

Outline of Convention Sessions

MONDAY MORNING, MAY 7

Opening Session

What's Ahead for Coal?
The Railroads and the Coal Industry

Business Luncheon—Future Energy Sources

MONDAY AFTERNOON

Strip Mining

Hanna's 60-yd Shovel
Time Study of Stripping Shovels
Time Study of Drag Lines

Maintenance

A Modern Maintenance Organization
A Preventive Maintenance Program
Maintenance of Ventilation and Power Conversion Equipment

Coal Miners Party—Monday Evening

TUESDAY MORNING, MAY 8

Continuous Mining

Pillar Extraction in High Coal
Continuous Mining in Low Coal
Complete Extraction in Illinois

Coal Preparation

Sludge Recovery and Water Conservation
The Joanne Preparation Plant
Barge Loading Systems

Luncheon—Sports Highlights

TUESDAY AFTERNOON

Roof Support

Factors in Estimating Overburden Support
Roof Bolting Symposium

Industrial Engineering

Benefits from Industrial Engineering
Problems in Industrial Engineering
Production Engineering

Baseball Night—Tuesday Evening

WEDNESDAY MORNING, MAY 9

Coal Preparation

Salvaging Coal from Washery Rejects
The Corbin, Kentucky, Cleaning Plant
Fine Coal Cleaning

Haulage & Power

Fire-Resistant Conveyor Belts
Automation of Main Haulage
Trends in Underground Power

WEDNESDAY AFTERNOON

Continuous Mining

Continuous Mining in Medium Coal
New Types of Machines
Power for Continuous Mining

Strip Mining

Haulage Road Construction
Truck Haulage with Large and Small Units
Drilling and Blasting

Annual Banquet—Wednesday Evening

Wheels of GOVERNMENT

As Viewed by HARRY L. MOFFETT of the American Mining Congress

★ ★ ★ ★ ★ ★ ★

Washington Highlights

TAX CUTS: Probable for individuals

RIGHT-TO-WORK: State laws before high court

TRADE ACT: Constitutionality under fire

WELFARE FUNDS: Hearings scheduled

FREIGHT RATES: New boost sought

LAND WITHDRAWALS: Under close scrutiny

MINERALS MOBILIZATION: Progress slow

★ ★ ★ ★ ★ ★ ★

THE second session of the 84th Congress convenes January 3 and the returning lawmakers will face a pile of unfinished business. In addition to the large number of bills—some 8000 of them—in various stages of the legislative process, remaining from the last session, the Congress will be confronted with new legislative programs advanced by the President and by the Democratic Party.

While the aura of political light will hang over the entire session, Congress will have to buckle down and act on several pieces of major legislation that are due to expire in 1956. Included among these are an extension of the Defense Production Act carrying provisions for mineral purchase and expansion programs, the foreign aid program, the corporate income tax rate scheduled to drop from 52 to 47 percent at April 1, export controls, some agricultural programs, and continuation of Federal aid in the housing field.

Left pending from the last session were such issues as farm price supports, customs simplification, SEC revisions, Natural Gas Act amendments, Federal highway legislation, Atomic Energy Act amendments, and broadening of coverage of the Social Security Act.

All in all the next session promises to be an interesting one, sprinkled with political oratory and featuring drives to enact laws that will attract the voters to the bandwagons of both political parties.

Tax Cuts Ahead

One of the outstanding issues that is likely to be considered from its political rather than its economic merits will be that of tax reduction. The Administration has indicated that a balanced budget is in the offing and that a small surplus may be in sight. High officials have cautioned that tax reductions should not be made until revenue receipts indicate that the Government can continue to operate on a balanced budget. They have not, however, closed the door to tax cuts about mid-year.

On Capitol Hill there are a number of influential Senators and Representatives who also feel that not only is a balanced budget necessary but that any surplus should be applied to reducing the huge Federal debt. However, this being an election year, it is entirely possible that tax slashes will be given to individuals in the form of increased exemptions and some reductions in excise taxes.

Meanwhile, a Congressional Joint Economic Subcommittee has concluded hearings on Federal tax policy during which such subjects as income taxes, capital gains taxation, depreciation, estate and gift taxation, taxation of foreign income, and taxation of small business came in for thorough study. During the course of the hearings full scale attacks on percentage depletion were launched by several members of the academic world. Professors from well known universities took the position that the United States would do better to conserve its mineral resources in the ground and expand overseas production. These men held that the percentage depletion allowance benefited a few at the expense of the public.

Refuting these statements, Henry B. Fernald, chairman of the Tax Committee of the American Mining Congress, pointed out that "Determination of taxable income from mineral extraction is a distinctive problem. The mineral sold is part of the capital asset represented by the mineral deposit itself." In mining, he said, the mineral that is exhausted is not replaceable and expenditures to find and develop other deposits are made without knowing what may result. He emphasized that most mineral deposits found never repay the expenditures for them and that the tax laws must recognize, as they do at present, the problems of the mining industry in order not to impair incentives for mineral production. He warned that if changes in depletion or other tax allowances reduce incentives which are based on expected net return after taxes "we cannot assume, as some do, that activity, expenditures and income will continue the same and greater taxes result." He declared that we must maintain a vigorous, active and well-equipped and well-trained mineral industry available for emergency, and while we may rightly acquire some minerals from abroad, this country "should not be wholly dependent on foreign supplies which might be cut off or limited in war or in peace."

These hearings are to form the basis for recommendations for some revisions in the tax laws, for consideration by the House Ways and Means Committee early in the session.

Right-to-Work Court Test

The question of whether State right-to-work laws, which bar compulsory union membership, supersede the Federal labor laws which permit union-shop contracts is now before the U. S. Supreme Court for determination. Some seventeen States have right-to-work laws on their statute books which leave to the worker the right to determine whether or not he wishes to join a union, and all of them will probably be affected by the final ruling of the high Court.

Before the Court is the question of

whether the Nebraska right-to-work law banning union shop contracts invalidates the Federal law permitting such contracts. The Nebraska Supreme Court had held that the Federal law offended the limitations of due process in this field and was inapplicable in the State. The case involved 15 railway unions who sought to unionize employes of the Union Pacific Railroad who refused to join the unions.

The case will be argued at an early date.

Another important labor case is also before the Supreme Court. It has agreed to rule as to whether a company may be forced to open its financial records to a union after it has declared that it cannot afford a wage boost. This case involves a request made by the AFL Ironworkers for a 10-cent an hour pay hike from the Truitt Manufacturing Co., Greensboro, N. C., which refused to grant more than a 2½ cent an hour increase and would not open its financial records to union inspection.

Trade Act Court Test

The first test case of the constitutionality of the Trade Agreements Act is now before the Federal Customs Court in New York, and regardless of the ruling handed down will find its way to the U. S. Supreme Court. The final decision, if it holds the Act unconstitutional, will have a wide impact not only at home but abroad.

A tuna canning company, the Star Kist Foods, Inc., has asked the Customs Court to declare the 1934 Trade Agreements Act unconstitutional on the grounds that (1) the Constitution provides that Congress alone has the legislative powers and that tariff treaties are legislative measures, (2) the changes made in tariff rates by the President are not in accord with the constitutional provision that all revenue measures must originate in the House of Representatives, (3) the Constitution reserves to Congress the exclusive power to regulate trade with foreign countries and to impose excise taxes, and (4) the tariff agreements negotiated by our Government are treaties and have not been approved by Congress as required by the Constitution.

Attorneys for the company have announced that they will carry the case to the Supreme Court if necessary. They charged, in a brief, that the President had no authority under the Constitution to reduce the tariff on tuna, and declared that the rate should be reestablished at the level set by Congress in 1930.

Justice Department attorneys said that while the constitutional issue had been raised in some past cases, this was the first time that any case was limited solely to this issue.

Under the Act, which has been extended and amended many times since 1934, hundreds of tariffs have been reduced by the United States in trade agreements, and more cuts are in the offing at the present negotiating session at Geneva.

Union Welfare Funds

A Senate Labor Subcommittee will resume its investigation of abuses of union welfare and pension funds on January 10. The Committee is seeking the views of labor and management as to the best way of minimizing such abuses through Federal legislation.

During earlier hearings, UMWA President John L. Lewis stated that he saw no need for new laws to safeguard such funds, but did support proposals requiring a public accounting of the financial operation of these funds. He told the subcommittee that, in his opinion, what was needed most was a little prosecution by the Government and union leaders, to rid the welfare funds of unscrupulous individuals involved in their administration.

Enders M. Voorhees, finance committee chairman of the U. S. Steel Corp., advanced the suggestion that if new safeguards are needed to conserve the welfare funds, they can be developed by the States through an extension of existing insurance and banking regulations.

Meanwhile, the AFL-CIO has announced its support of Federal legislation requiring full public disclosure of the financial operations of welfare and pension funds. The newly-merged union also adopted a code of ethics for welfare fund administration designed to keep the operations of such funds in good order.

New Freight Rate Hike?

Following a series of meetings of rail traffic executives, the nation's carriers are seeking an immediate 7 per cent increase in freight rates and charges to offset boosts in rail wages.

In announcing their intention to seek the rate hike the railroads said "the 7 per cent increase is the minimum necessary to offset the cost of recent railroad wage and material price increases, which amount to more than half a billion dollars."

On December 27, approximately 500 of the carriers joined in a petition asking for the increase and for permission to file tariffs to become effective February 9. In filing the petition, the railroads pledged that they would make refunds in the event the increase should be scaled down or rejected by the Interstate Commerce Commission. ICC Chairman Johnson had indicated to the carriers that the procedure was legally possible but declared that the suggested timetable for putting the rates into effect was clearly inadequate. Under normal processes the ICC makes an extensive investigation of rate increase pleas, which often takes up to a year to complete. During the past ten years the roads have received four rate hikes totaling some 79 per cent.

The new petition is headed for stiff opposition from coal and other branches of the mining industry, as well as from agriculture and other industries which feel that the present rates are excessive.

Land Withdrawal Investigation

On January 4 and 5, the House Interior and Insular Affairs Committee will hold hearings into the inroads upon use of public lands made by Federal withdrawal of such lands from mineral entry or acquisition by various agencies of the Government.

Land withdrawals, particularly by the military, have been the subject of much criticism throughout the West and were discussed at some length during the recent Las Vegas meeting of the American Mining Congress. At that time, mining men made it clear that many of the withdrawals were adverse to mineral development and that many of them were undertaken while other lands, already in military control, were lying idle.

Suggestions have been advanced by representatives of the mining industry that Congress investigate the withdrawals to determine the necessity for and authenticity of the various withdrawals, whether the land is still serving the purpose for which it was withdrawn or acquired, and whether portions or the whole of many of the withdrawals could not be returned to the public domain or to private ownership. It is probable that the Committee will look into all of these matters with a view towards more stringent controls over military withdrawals.

Representatives of the Interior Department, the Army, Navy and Air Force will testify at the hearings. Meanwhile, Assistant Secretary of Interior for Land Management Wesley A. D'Ewart has halted the processing of all requests from Federal agencies for land withdrawals, pending the outcome of the hearings.

OMM Hearings

The House Interior Committee has held an executive hearing to determine what progress has been made by the Office of Minerals Mobilization in establishing programs and policies for maintenance of mobilization bases for the various branches of the domestic mining industry. The Committee sought to determine to what extent OMM has devised programs for a long list of metals and minerals, ranging from antimony to zinc. It also sought to find out what recommendations had been made to the Office of Defense

(Continued on page 72)

AMC Personals

Frederic W. Hammesfahr has been appointed to the position of assistant to the vice-president—development, of Pittsburgh Consolidation Coal Co. He was formerly manager of the Process Development Section of General Electric's Metallurgical and Chemical Division. In his present capacity he will analyze, develop and exploit chemical opportunities for Pitt-Consol.

Edward R. Scammell has been named plant manager at Western Phosphates, Inc., Garfield, Utah, according to E. I. Lentz, vice-president and general manager. Scammell, who succeeds Lentz as manager of the large fertilizer and chemicals plant, comes to Western Phosphates from the Trail, B. C., commercial fertilizer plant of Consolidated Mining and Smelting Co., where he was superintendent.

The appointment of **Jesse F. Core** as general superintendent of the Frick District mines of U. S. Steel's Coal Division, with headquarters in Uniontown, Pa., has been announced. He succeeds **William R. Stedman** who has been made staff assistant to the vice-president in charge of coal operations.

At the same time the appointment of **August R. Werft** to succeed Core as chief engineer for the Frick District mines was made. Before coming to U.S. Steel Core worked for four leading coal companies. Starting in 1935 with Hillman Coal and Coke he worked first as a miner. In 1938 he joined Pittsburgh Consolidation Coal Co. being employed in various capacities until 1947 when he became chief engineer at Nemacolin Mine for the Buckeye Coal Co. He then served in the same capacity for Island Creek Coal Co. at Holden, W. Va., from 1950 to 1951 when he came to U. S. Steel's Frick District as mining engineer. He was made chief engineer for the district in 1954.

Jesse F. Core

Werft joined U. S. Steel as assistant mechanical engineer for the Frick District in 1943. He was an assistant general superintendent at the time of his present appointment.

Ernest V. Gent, who served the American Zinc Institute, Inc., for 20 years, first as secretary than as executive vice-president, retired from office December 31. **John L. Kimberley,** formerly secretary of the Institute, has been appointed executive vice-president, succeeding him.

E. V. Gent

J. L. Kimberley

Gent has been active in zinc industry affairs since 1925 when he was manager of the Zinc Export Association. He became secretary of the American Zinc Institute in 1935, and in 1941 was named special consultant to government agencies. He has served as executive vice-president of the Institute since 1948 and will continue to serve as a special consultant.

The appointment of **L. A. Smith** as assistant to the president, Bell & Zoller Coal Co., was recently made by that company. At the same time it was announced that **Warren Wurzburg** has been appointed as general manager of sales for the company.

Warren Smith has been named mine superintendent for the development of the Toquepala mine now being undertaken by the Southern Peru Copper Co. For the past five years he was pit superintendent of the Lavender open cut mine of Phelps Dodge Corp., Bisbee, Ariz. **E. McL. Tittman,** former general manager for American Smelting & Refining Co., is president of Southern Peru Copper Co.

Quinton T. Martin was recently appointed to the newly created position of manager—industrial engineering, Oliver Iron Mining Division of U. S. Steel Corp. Martin has been with Oliver since 1951.

J. L. Hamilton, vice-president in charge of operations, Island Creek Coal Co., has announced the appointment of **J. E. Osmanski** as manager of personnel. Osmanski was director of personnel at Crucible Steel Co. of America in Pittsburgh, Pa., before coming to Island Creek. Prior to his employment with Crucible, he was an Associate Professor of Industrial Psychology at Penn State University. At Island Creek he will be responsible for executive and technical recruitment, management training and development, salary administration, and personnel policies.

D. M. Kentro has joined the Shattuck Denn Mining Corp. as an assistant vice-president. Kentro had been with the Atomic Energy Commission as Assistant Director for Domestic Production, Division of Raw Materials.

Dr. Charles E. Lawall, former president of West Virginia University and more recently assistant vice-president of coal traffic for the Chesapeake and Ohio Railway, has been named assistant to the president, coal traffic and development, of the C & O. He succeeds the late J. W. Bahen.

A prominent educator and coal mining engineer, Lawall joined C. & O. in 1945 as engineer of coal properties. He had been president of West Virginia University for seven years. He also served the university as director of the school of mines and as a faculty member.

The American Smelting and Refining Co. recently promoted **Ralph Hennebach** to assistant general manager of the company's western department, with headquarters in Salt Lake City. For the past two years, Hennebach has been an ore buyer in the New York Office of the company.

The Department of Interior has announced the appointment of **T. Reed Scollon** as chief of the bituminous coal division of the U. S. Bureau of Mines. Scollon will direct the Bureau's technical and economic research and other programs concerned with bituminous coal and lignite, explosives, and air and stream pollution.

G. R. "Buffalo" Kennedy, former vice-president and general manager of Navajo Uranium Division, Kerr-McGee Oil Industries, Inc., has joined Rio De Oro Uranium Mines, Inc., as consultant. The firm is a Grants, N. Mex., area operator.

DeWitt C. Snyder, executive vice-president of C. H. Sprague & Sons Co., has been elected president of Sterling Smokeless Coal Co. and Mount Hope Coal Co. to succeed the late Thomas H. Snyder.

D. C. Snyder

At the same time, **Paul Q. Warden,** formerly general superintendent was elected to the board of directors and named vice-president and general manager at a meeting of the directors of the two firms. Warden will direct the coal production of both Sterling Smokeless and Mount Hope Coal Co.

Carl A. Arend, Jr., formerly manager of Carlsbad operations for International Minerals & Chemical Corp., recently moved into the position of general manager of the potash division with headquarters in Chicago. Arend was succeeded at Carlsbad by **E. C. Skinner,** who had been general superintendent; **C. E. Presnell** took over the position of general superintendent, succeeding Skinner.

At the recent meeting of the Idaho Mining Association at Sun Valley, Idaho, the following officers and directors were elected: **L. E. Traeger,** superintendent of production for Anaconda company's phosphate division, president; **J. C. Kieffer,** general manager, Northwest Mining Department of American Smelting & Refining Co., vice-president; **Josiah Work,** general manager, Westvaco Chemical Div., vice-president; **R. E. Sorenson,** vice-president and chief geologist, Hecla Mining Co., director; **Malcolm Brown,** president of Sidney Mining Co., director; **Roger H. McConnel,** chief geologist, Bunker Hill & Sullivan Mining and Concentrating Co., director; and **Edwin B. Douglas,** manager, Calera Mining Co., director. **Harry W. Marsh,** Boise, was reelected secretary-treasurer of the group.

— *Obituaries* —

R. H. Sherwood, 79, president of Sherwood-Templeton Coal Co., and board chairman of the Stonefort Corp., both of Indianapolis, Ind., died December 2.

Mr. Sherwood was trained as an electrical engineer, entering the coal business some 40 years ago. He was especially noted for his improvements in coal mining and coal preparation techniques. He gave unstintingly of his time to the coal industry including long and valuable service with Bituminous Coal Research, Incorporated; in 1953 he was given the BCR award for his contributions.

J. William Bahen, 50, assistant to the president in charge of coal traffic and development for the Chesapeake and Ohio Railway, died November 11 at C. & O.'s Greenbrier Hotel, White Sulphur Springs, W. Va.

A native of Richmond, Va., Mr. Bahen joined the C. & O. there as a young man. He rose steadily in the organization, and was transferred to Cleveland in 1939. In 1944, he became assistant to the vice-president in charge of coal traffic and development, and four years later was named assistant to the president. He was to have been promoted to a vice-presidency at a forthcoming meeting of the C. & O. directors.

MAX SCHOTT

AN APPRECIATION

BY DENNIS F. HALEY,
Retired Vice-President,
Climax Molybdenum Company

THE mining and metals industries lost one of their outstanding pioneers and steadfast good friends November 10 with the passing of Max Schott, member of the board of directors and retired president of Climax Molybdenum Co.

Max Schott was gifted with the indomitable curiosity that makes men pioneer. Search for new knowledge, new materials and better ways to do things was an innate part of his nature from the time of his birth in Russelsheim, Germany, on March 15, 1876, until his death in New York, N. Y., nearly 80 years later. It caused him before his seventeenth year to migrate from Germany to America where he was virtually without a friend. It caused him to educate himself at night school (New York University) in metallurgy and law while picking up English and Spanish and working as a clerk in the offices of American Metal Co., Ltd.

With American Metal, Max Schott learned the mining and milling of non-ferrous metals from underground up. By 1917, Max Schott had worked his way through the ranks to managership of the American Metal Co. Denver Colo., office. It was there that he became interested in molybdenum. Because of his faith in the future value of molybdenum and at his instigation that Climax Molybdenum Co. was organized. He agreed to become its first general manager in the early formative years of the company, and was elected president in 1930.

Under Max Schott molybdenum became important the world over as one of the foremost alloying materials for iron and steel and the operations on Bartlett Mountain began to develop into what was to become the largest underground mine in North America. With his leadership great strides were made in mining and milling methods, strides adopted by mining operations all over the world.

Thomas Hubert Snyder, 72, president of Sterling Smokeless Coal Co. and Mt. Hope Coal Co. died November 14 at his home in Mt. Hope, W. Va.

Carl J. Trauerman, secretary-manager of the Mining Association of Montana, aged 70, died at his home in Butte on December 17. He had been ill of a heart attack for a week preceding his death. Mr. Trauerman had broad experience in all phases of mining throughout the United States including assaying, surveying, research, flow sheet design, managing, inventing of metallurgical devices, financing mineral properties and serving as corporate executive. He entered the oil and gas business in 1920, had his own brokerage firm in Butte from 1926 to 1938 and was editor of the Montana Natural Resources Bulletin from 1923 to 1931.

In 1935 he purchased control for himself and others of the Ruby Gulch Gold Mining Co., a Montana gold mining venture, and became president of that concern.

Mr. Trauerman was active in professional and trade association activities and devoted most of his time in later years to the Montana Mining Association, of which he was president for seven years. A conservative democrat, Mr. Trauerman was actively interested in politics and served as delegate to the Democratic National Convention at Houston in 1928.

M.C.J. to Publish Coal Year Book Material

Proceedings of annual American Mining Congress Coal Conventions, which have been published in the *Coal Mine Modernization* Year Book since 1927, will be carried in MINING CONGRESS JOURNAL and will thereby be circulated to a far greater number of readers in all branches of the mining industry, including metal mining and industrial minerals, as well as coal mining. The JOURNAL, besides giving this material much broader distribution, will itself be enhanced by these splendid articles. The 1955 Coal Mine Modernization Year Book is the final edition.

Tennessee Zinc Mine Work

New Jersey Zinc Co. has started development work on its recently-acquired Flat Gap property at Treadway, Tenn., 25 miles from its Jefferson City property where a similar project has been under way for the past two years. Installation of power facilities has been completed and shaft-sinking operations are under way. A service shaft and a ventilation shaft are to be sunk.

Trackless mining will be employed at Flat Gap. All underground ore haulage will be by diesel trucks. Trucks will also be used to transport concentrates from a proposed mill of 2000 tpd zinc-ore capacity to a railroad shipping point at Morristown, Tenn.

The orebody is a lead-free zinc sulfide ore, typical of the ore occurrences in eastern Tennessee.

Development of the two Tennessee mines is part of a comprehensive program to increase the company's ore supply. Similar mine development work is under way at company properties in Pennsylvania and Virginia.

Coal Leases Acquired

The West Kentucky Coal Co., Madisonville, Ky., has acquired coal rights and leases on 12,500 acres of land in Union County, Ky., for future development. The land, on the Ohio River below Uniontown, was purchased from the Truax-Traer Coal Co., Chicago, and has proven reserves of about 45,000,000 tons of recoverable No. 9 coal.

Iron Ore Carriers Set Record

Great Lakes iron ore carriers last season established an all-time peace-year tonnage record, the Lake Superior Iron Ore Association has reported. Shipments totaled 87,459,853 tons, about 4,000,000 tons above the previous high semi-war year of 1950 and only 9,000,000 tons under the all-time record of 95,844,449 tons established in 1953.

A huge amount of repair work is being done on lake ships this winter, indicating that the ore carriers will work at top speed again the coming season.

Elected NAM Director

Howard I. Young, president, American Zinc, Lead & Smelting Co., St. Louis, Mo., and president, American Mining Congress, has been elected a director of the National Association of Manufacturers. He has been active in the work of the NAM for the past 15 years, having previously served as regional vice-president for the south-central region, as well as on the board of directors.

USBM Director Retires

John J. Forbes, director of the U. S. Bureau of Mines for the past four years, retired November 30 after 40 years of Federal service. Director Forbes reached the mandatory retirement age on November 21.

When Forbes began his Federal service in 1915, the Bureau of Mines had been in existence for only five years. It was operating on a budget of $758,000 and had about 400 employes. The Bureau now has about 4000 employes and the current year's budget is $28,563,000.

Before joining the Bureau as a first-aid miner in 1915, Mr. Forbes served various capacities in a number of coal mines in Pennsylvania and Ohio. Serving the Bureau successively as foreman miner, junior mining engineer, mining engineer, senior mining engineer, and principal mining engineer, in July 1927 he was appointed supervising engineer of the Safety Division and was stationed at Pittsburgh, Pa., then the main field office for the division. He continued in that capacity until September 1941, when he was appointed chief mine inspector for the Bureau to supervise activities under the newly authorized Federal Coal Mine Inspection and Investigations Act of 1941. He came to Washington in 1942 to direct the Bureau's Mineral Production Security Division, charged with the job of insuring continued production of vital war materials. Upon conclusion of this program, Mr. Forbes was advanced to assistant chief of the Health and Safety Branch and again assumed supervision of the Coal Mine Inspection Division. Three years later he was named chief of the Health and Safety Division and continued in that position until his appointment as director of the Bureau in November 1951.

Oliver Iron Ore Shipments

Oliver Iron Mining Division of U. S. Steel Corp. closed its 1955 ore-shipping season with 36,200,000 tons of ore shipped to steel mills, 9,500,000 tons of ore more than shipped in 1954.

Oliver's shipments in 1955 included 6,000,000 tons of iron-ore concentrates, about 10 percent of which was taconite nodules and sinter. Principal source of iron concentrates produced from low-grade ores is Oliver's Canisteo district (Minnesota) operations, where a new unit was added to the Arcturus iron ore concentrator this year. It is capable of treating ores containing only 35-40 percent iron which are now being mined in the Marble area.

Oliver will conduct extensive operations this year at two new mines, the Sharon, near Buhl, Minn., where power lines and mine roads are now being constructed, and the Sauntry mine, north of Virginia, Minn., where power lines are being installed and mine roads are being constructed preparatory to the removal of overburden.

4000 New Coal Cars

The Norfolk & Western Railway will build 4000 new open-top freight cars at a cost of $30,000,000 in its own shops. The new cars will consist of 3500 all-steel coal hoppers of 70-ton capacity and 500 all-steel gondola cars of 50-ton capacity.

This brings the number of new freight cars ordered by the N & W during 1955 to 9100. Their total cost will be $69,585,000. More than half the cars have already been delivered.

Organization Changes Made

The board of directors of the American Zinc, Lead & Smelting Co., St. Louis, Mo., have approved a number of organization changes within the company and its subsidiaries.

Howard Lee Young has been elected a vice-president. He has been associated with the company since 1937, when he joined American Zinc Sales Co., Columbus, Ohio, as salesman and advertising manager. In 1952 he was made manager of the Metal and Acid Sales Department and in 1954 was appointed vice-president of the American Zinc Sales Co.

H. L. Young

William J. Matthews, Jr., connected with the company for 39 years, has been elected vice-president and treasurer. He has served as cashier, general auditor, and since April 20, 1948, as secretary-treasurer.

Clarence V. Burns, a company employe for 32 years, has been elected vice-president and controller. He has served in various accounting capacities at the company's Montana, Tennessee, and Missouri operations, and since 1948 has been assistant secretary-treasurer.

W. J. Matthews

C. V. Burns

R. C. Perkins

G. L. Spencer, Jr.

The new secretary of the company is Ralph C. Perkins, who will continue his duties as chief counsel of the company. He has served as the company's assistant secretary and counsel since 1942.

John R. Griffiths, connected with the company since 1949, has been appointed director of industrial relations for the company and its subsidiaries. He had previously served as assistant director of industrial relations and counsel.

George L. Spencer, Jr., has been elected vice-president of a subsidiary, the American Zinc Co. of Illinois. He has been general superintendent of the company's operations at East St. Louis, Ill. since 1940.

L. P. Davidson, who has been general superintendent of the Electrolytic Division, Monsanto, Ill., since 1940, has been promoted to the position of manager of that division.

Thomas I. Moore succeeds Davidson as general superintendent of the Electrolytic Division at Monsanto. He has been employed by the American Zinc Co. since 1927, and has been assistant superintendent at Monsanto since 1941.

Dale I. Hayes, formerly western manager of the company, has been named assistant to the president of the American Zinc, Lead & Smelting Co. with headquarters at Knoxville, Tenn.

John W. Currie, who has been general superintendent of the company's Grandview Mine at Metaline Falls, Wash., has been promoted to resident manager, and Ewald A. Frick has been promoted to assistant resident manager.

Technical Department Set Up

International Minerals & Chemical Corp., Chicago, has established a technical department at its Bonnie phosphate chemicals plant near Bartow, Fla. Responsibilities of the technical department include processing and quality control, new developments, and liaison between the engineering and research divisions of the corporation relative to process problems.

Raymond E. Tuttle is manager of the new department, which consists of the currently-operating process engineering group and chemical control laboratory. He has been chief process engineer at Bonnie for the past year.

PCS Fights Rate Hike

The Alabama Public Service Commission has served notice that it will fight a rate increase on rail shipments of coal scheduled to go into effect December 28, 1955.

The rate increase was authorized in October by the Interstate Commerce Commission.

APSC president C. C. Owen said that ICC's order was "highly discriminatory" and he accused the ICC of tampering with the "sovereign rights" of states to regulate commerce within their borders.

The ICC directed an increase in rates of shipment of coal from Alabama mines to other points within the state. The APSC said it would seek an injunction in Federal Court to halt the increase and would carry the fight to the U. S. Supreme Court if necessary.

Expansion Goal Raised

Bessemer Limestone & Cement Co., Youngstown, Ohio, will boost its current $3,600,000 expansion program by an additional $700,000. The company's board of directors has approved the expenditure of the additional funds for 1500 hp compartment mill and a building.

The mill will furnish additional cement finishing capacity to supplement the equipment being installed in the original program, raising Bessemer's capacity by 50 percent.

Mining Symposium Conducted

The 17th Annual Mining Symposium of the University of Minnesota was held at Duluth January 10 and 11 in connection with the annual meeting of the Minnesota Section of A.I.M.E. A comprehensive program covering iron-ore mining operations and beneficiation was presented.

West Virginia Aluminum Plant

Kaiser Aluminum & Chemical Corp., Oakland, Calif., will construct a new aluminum reduction plant at Ravenswood, W. Va., which will increase the company's primary aluminum capacity by 220,000 tons. The new reduction plant, to be constructed at a cost of $120,000,000, is part of a scheduled $280,000,000 expansion program which will include additional aluminum works, fabrication facilities, and chemical production.

Orient Mine Resumes Production

Freeman Coal Corporation's Orient No. 3 coal mine at Waltonville, Ill., has full crews at work again following an underground fire which halted production for seven weeks.

The fire erupted from a severed electric power cable. Mine rescue crews, aided by regular Waltonville miners, reduced the size of the fire area through the construction of tunnel seals. Tons of carbon dioxide dumped into the mine through a shaft drilled from the surface snuffed out the blaze.

Orient No. 3, one of the most modern collieries in southern Illinois, produced over 1,500,000 tons of coal in 1954 and normally employs over 400 men.

Turn the page →

Island Creek Adds Properties

The board of directors of Island Creek Coal Co., Huntington, W. Va., has approved a plan for acquisition of the physical assets, leaseholds, stores, and sales facilities of the Red Jacket Coal Corp., Columbus, Ohio. The effective date of the acquisition, which will be accomplished through exchange of 250,000 shares of Island Creek common stock and $1,000,000 cash, is dependent upon mutually satisfactory completion of necessary legal and technical details, R. E. Salvati, Island Creek president, has said.

Consummation of the transaction will add to Island Creek's holdings a substantial reserve acreage of high, medium, and low volatile coals in West Virginia, and seven modern operating properties producing approximately 4,000,000 tons annually. The mines, each with its own modern preparation plant, are located at Red Jacket, Mingo County, W. Va.; Coal Mountain and Wyoming, Wyoming County, W. Va.; and Keen Mountain, Buchanan County, Va.

The Red Jacket acquisition is the latest of several major steps taken within the past 20 months by Island Creek. In 1954, Island Creek purchased the entire coal marketing division of the Cleveland-Cliffs Iron Co., Cleveland, which at the time annually marketed some 4,000,000 tons of coal. The purchase included loading docks at Duluth, Minn., and Port Huron and Green Bay, Wis. Island Creek also acquired Cleveland-Cliff's interest in the Escanaba Coal & Dock Corp.

Last August a physical merger of Island Creek and Pond Creek Pocahontas was effected, with combined total assets of $55,000,000.

The acquisition of Red Jacket will establish Island Creek Coal Co. as the second largest coal mining and marketing operation in the United States, increasing its annual sales volume of owned and agency coal from 14,000,000 to 18,000,000 tons.

Winter Stripping Planned

Snyder Mining Co., which has concluded iron ore shipments for the 1955 season from its open-pit iron mines at Hibbing and Buhl, Minn., plans to do stripping work at both mines during the winter.

Enters Rare Earth Field

Michigan Chemical Corp., St. Louis, Mich., has entered the rare-earths field by acquiring the assets of Saturnium Corp., California, Ky. In its new activity, the company will continue rare-earths researches as well as place in operation other plant procedures now ready for commercial applications. The Saturnium research laboratory at California will be closed and its facilities moved to St. Louis, Mich.

Technical director of Michigan Chemical's new rare earth division will be Dr. Herbert J. Fleischmann, who organized Saturnium several years ago for research and development in the rare-earths field.

Cement Production Expanded

Pittsburgh Coke & Chemical Co. is expanding its cement manufacturing facilities on Neville Island in the Ohio River near Pittsburgh. The expansion, to cost $500,000, will raise the company's annual capacity by 400,000 bbl and boost its total cement capacity to more than 2,000,000 bbl per year.

Ohio Coal Mine Reopens

The Ohio Land & Railway Co., Columbus, Ohio, has reopened the old Rendville mine, with an initial crew of 33 men employed in one-shift operations. The mine, formerly operated by the Denise Coal Co., has been rechristined the Avis by its new owner. Production will be boosted to about 1800 tpd.

Ohio Land & Railway Co. has about 3000 acres under lease in the Rendville area, which are said to contain 25-year reserves of coal.

Mine Roof Weathering

(Continued from page 53)

6. The principal minerals in Pennsylvanian shales forming mine roofs are mica, feldspar, quartz, organic material, illite, kaolinite and chlorite.

7. Laboratory research indicates that when clay minerals exchange inorganic for certain organic cations (namely fatty amine acetate), the minerals become less plastic, shrink and swell less, and are more resistant to slaking. Research looking toward impregnating roof shales with such cations before mining might disclose very valuable information. Also incorporating such material in paints might improve their effectiveness when applied for roof control purposes.

8. Clay minerals such as kaolinite and good crystalline illite and chlorite are often associated with satisfactory roof shales. Expanding mixed lattice minerals and montmorillonite are often associated with unsatisfactory roof shales. Shales in which sand size particles dominate are often described as forming good roof but shales in which silt size particles dominate are often described as forming unsatisfactory roof.

9. The composition of shales varies through rather wide limits from one location to another, as well as from one stratum to another, at the same location. Consequently, as the physical properties of these shales are to some extent dependent upon the mineral content of the shales, one need not be surprised at abrupt changes in physical properties in the shales.

10. More research is needed on the mineralogy of mine roof shales and upon the physical properties of roof shales as related to their mineralogy.

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Western States

Tooele Tunnel

McFarland and Hullinger, Tooele, Utah, mine contractors, are engaged in driving a 2000-ft exploratory tunnel through the porphyry at the Ophir Hill mine 18 miles southeast of Tooele. The firm received a $52,350 exploratory loan on a $104,700 project several months ago from the Defense Minerals Exploration Administration for lead and zinc exploration. The contractors have been mining east of the porphyry for several years on a lease from U. S. Smelting Refining & Mining Co., and are now seeking similar ore west of the porphyry.

Second Vein Opened at Custer Mine

The Highland-Surprise Consolidated Mining Co. has opened a second mine structure for about 100 ft in its Custer County, Idaho, property. Mine officials said the vein is wider than the eight-ft drift which traverses a well mineralized footwall zone in what appears to be good grade lead ore. A zinc vein showing good values had previously been exposed for a distance of 45 ft and diamond drilling is under way to determine values across the remainder of the wide vein. Superintendent Tibor Klobusicky disclosed that about 800 ft of crosscutting and drifting has been done under a $59,750 contract with the Defense Minerals Exploration Administration calling for some 1350 ft of work. Sunshine Mining Co. is financing Highland's share of the costs under a profit-sharing agreement.

New Borax Facilities

Pacific Coast Borax Co., division of Borax Consolidated, Ltd., of London, has awarded a joint-venture contract to Southwestern Engineering Co. and Ford J. Waits Co., both of Los Angeles, for the engineering and construction of new plant facilities, according to James M. Gerstley, president. The new installations, which will represent an investment of $18,000,000, will be located at Boron, Calif.

The new concentrating and refining plants are being constructed in order to handle the variety of ores which will be recovered when the company changes over to an open-pit operation. The conversion to open-pit mining and the expansion of facilities are the result of a marked increase in the demand for boron compound and borax since the war, Gerstley said. The new facilities are scheduled to be in operation by the middle of 1957.

Montana Iron Ore

The Young-Montana Co., a new iron ore mining operation in Montana, expects to ship over 75,000 tons of ore next year from leased holdings on the Running Wolf range, 75 miles southeast of Great Falls, Mont., according to E. A. Young, president. The ore will be shipped to the head-of-the-lakes for use in the Lake Erie district.

Ore reserves of the Bessemer-lump type on the properties are estimated at about 1,000,000 tons. Open-pit mining methods will be employed in the operation.

Atlas Buys Almar Control

Atlas Corp., through its wholly owned subsidiary, Hidden Splendor Mining Co., has acquired a 66½ percent interest of the Almar uranium mine in Utah. The aggregate purchase price exceeded $8,000,000 in cash.

The 66½ percent interest was purchased as follows: 51 percent through the purchase of all of the outstanding stock of Almar Minerals, Inc., from Merritt K. Ruddock, of Denver, and members of his family, and 15.5 percent from Homestake Mining Co. and others who held participating rights in the Homestake interest. Upon completion of the transaction, Atlas liquidated Almar Minerals, Inc., giving Hidden Splendor Mining Co. direct ownership of the 66½ percent interest.

More than 125 core holes have been drilled on the property and in October a 530-ft mining shaft was completed. Development and mining operations so far developed will be carried forward by Hidden Splendor.

Idaho Maryland Tungsten

Idaho Maryland Mines Co. is continuing development of its tungsten ore deposit at Grass Valley, Calif., according to Bert Austin, president. The company has sufficient ore blocked out to warrant the construction of a tungsten mill at the mine, Austin said. The company is also milling several hundred tons of gold ore each week.

Wage Boost at Pend Oreille

A wage boost of 20 cents an hour including 17 cents in wages and three cents in fringe benefits is included in a new contract negotiated between Local 515, International Union of Mine, Mill and Smelter Workers, with Pend Oreille Mines and Metals Co. according to Manager W. L. Zeigler. The contract runs for three years but can be opened July 1 on wages and fringe issues.

Idaho Potash Exploration

The Potash Co. of America plans an exploratory tunnel for phosphate reserves in Bear Lake County, Idaho, according to J. P. Hesler, engineer in charge. The operation also will determine the efficiency of the application of coal mining methods to phosphate mining, Hesler said.

New Mexico Mine Reopens

Illinois Zinc Co. has announced the reopening of its Kearney zinc and lead mine at Hanover, N. Mex. Ore production has started and regular shipments are under way to the firm's concentrating plant at Deming. Production will be increased as soon as enough miners are available to conduct operations on two shifts.

New Health Regulations

New health regulations regarding testing for radon gas in connection with uranium mining in Utah were announced recently. The report was made by Otto A. Wiesley, chairman of the Utah Industrial Commission, following mining firm conferences at Green River, Moab and Monticello, Utah.

Miles P. Romney, manager of the Utah Mining Association, and Duncan Holladay, U. S. Public Health Service representative of Salt Lake City, accompanied Wiesley on a three-day excursion into Utah's uranium country where the miners were taught how to test for the radio-active gas at the working face. "The schools were in line with a promise made last summer at Grand Junction, Colo., that we would instruct miners in use of equipment for detection of radon gas," Wiesley said.

Alaska Coal Testing

The U. S. Bureau of Mines has announced the establishment of a coal-testing laboratory in Alaska to insure the delivery of quality fuel to air bases in other Federal establishments in the territory. Equipment has been installed in the Elmendorf Air Force Base, near Anchorage, where samples from shipments to that installation and other military bases in Alaska will be analyzed regularly to determine whether the coal delivered by Alaskan mines is of the grade specified. Alaska now has seven producing mines. Most of the coal output goes to Government bases.

The laboratory at Elmendorf also will analyze prospectors' coal samples without charge as well as specimens submitted by prospective bidders on future Government contracts in the territory.

Western Headquarters Established

The American Zinc, Lead & Smelting Co., St. Louis, Mo., has established headquarters for the western operations of the company and its subsidiaries at Salt Lake City, Utah. The company has western mining interests in Washington, Colorado, Utah, Nevada, and Arizona. The western office will be under the management of R. E. Calhoun. H. F. Mills, chief western geologist, will also make his headquarters in Salt Lake City, as will other engineers and geologists required in the management of the company's western activities.

Calhoun, associated with American Zinc since 1926, has been southwestern representative of the company since 1950 with headquarters at El Paso, Tex.

Mills joined the American Zinc organization in 1927, and he has been chief western geologist with the company since 1951.

Bunker Hill Expansion

Plans for a $7,000,000 expansion program at its zinc smelter at Kellogg, Idaho, have been announced by Bunker Hill & Sullivan Mining & Concentrating Co. The immediate goal is to increase monthly capacity by 2400 tons, according to W. G. Woolf, general manager.

The monthly capacity of the plant is now 4800 tons of slab zinc, which will be increased to 1200 tons in 18 months. Work on the expansion program will start as soon as weather permits.

Annual Meeting

(Continued from page 54)

said he would conduct an investigation to ascertain just how much the foreign governments have reduced their tariffs and quotas on United States products.

He was critical of many phases of the foreign economic aid program under which, he said, other countries are using United States funds to build factories to compete with U. S. business. Our Nation's objective, he declared, should be to protect American industry first, then to foster foreign trade and economic recovery.

The Virginia senator said he was strongly opposed to any foreign trade proposal which involves giving control of our tariff structure to an international body such as GATT or OTC. The U. S. Congress should retain its constitutional right to legislate all U. S. trade programs, he declared.

Byrd warned of the danger involved in tampering with our already "actuarially unsound" social security system, particularly stressing repercussions which would follow a reduction from 65 to 62 years in the retirement age qualification for women. If this concession were approved, he said, it would naturally follow that there would be pressure to lower the retirement age qualification for men to the same level.

It would be dangerous to reduce taxes on the basis of our present "super prosperity," he asserted, pointing out that public debt has increased to the point where it is equal to the total assessed value of all property in the United States. "It is time to put Santa Claus in the deep freeze," Byrd declared, because our generation has piled up most of the national debt and should feel obligated to start paying it off.

Northwest Mining Meet

The Northwest Mining Association held its annual convention in Spokane, Wash., on December 2-3. Interesting sessions were held dealing with mining and milling techniques, atomic power, exploration, uranium, metallurgy, and recent developments in Canadian mining.

Karl W. Jasper, president, Grandview Mines, was re-elected association president; R. D. Leisk, Sunshine Mining Co., vice-president; P. Evan Oscarson, consulting geologist, vice-president; Robert J. Towne, Towne Equipment Co., secretary; and E. K. Barnes, Spokane, banker, treasurer.

New Mexico Copper Reopens

The Henry Clay mine, Hidalgo County, N. Mex. which was first operated in 1878, is being readied for production by Brannon & Fuller of Silver City, according to the Office of the New Mexico State Inspector of Mines. Operations at this property were discontinued in 1929. The 400-ft shaft is presently being repaired in preparation for reopening.

La Sal Uranium Mill

The U. S. Atomic Energy Commission and Continental Uranium, Inc., of Grand Junction, Colo., have signed a contract for the construction and operation by Continental of a uranium processing mill at La Sal, Utah. Construction of the plant is expected to begin promptly, with completion scheduled for the summer of 1956.

The new uranium mill will be owned and operated by Continental Uranium, Inc., and the entire output of uranium concentrates will be purchased by the Commission. Completion of the La Sal mill will bring to 14 the number of uranium processing mills operating in the western United States.

The La Sal mill will process uranium ore produced from properties owned, leased or controlled by Continental, as well as uranium ores bought from independent producers.

Kennecott Research Center

Staff members of the recently organized engineering department of Kennecott Copper Corp., Western Mining Divisions, have taken over a newly constructed wing at the Kennecott Research Center Building on the University of Utah campus. The two-story wing will provide office space for a staff of 42 which will handle major engineering problems for Kennecott's four Western States divisions in New Mexico, Arizona, Nevada and Utah.

Henderson Plant Sold

Controlling interest in the Western Electrochemical Co., which operates a large plant at Henderson, Nev., has been acquired by American Potash & Chemical Corp., of Trona, Calif., according to Peter Colefax, president.

Few changes will be made in the operation of the Henderson plant, according to Colefax, except that of intergrating its function with American Potash operations at Trona. The metallurgical processing of borium, and other metals produced at Trona will be undertaken by American Potash at Henderson.

Fred D. Gibson will remain as vice-president and general manager of the Henderson plant, while Robert S. Burns, retiring president of Western Electochemical will remain with the company in a consultant capacity.

Wheels of Government

Continued from page 59)

Mobilization for carrying out any programs developed. The net result of the testimony was that no recommendations had been made as to any programs but that studies were under way on a number of minerals.

The Committee was also told of the formation of 14 advisory groups to OMM, and plans for meetings with these groups to develop recommended programs. OMM was urged by Committee members to expedite its work and to bring forth some concrete results by early this year. It is expected that hearings will again be held by the Committee this month to determine what has been accomplished. Lacking development of any formal recommendations by OMM, the Committee is likely to take the lead in drafting legislation for some of the most critical of the minerals and metals, and speed it through the House.

Meanwhile, OMM has held meetings with advisory committees on asbestos, beryl, chrome, manganese, tungsten, mica, and columbium-tantalum, but the results of these gatherings have not been announced. It is understood that most of the committees urged continuation of mineral purchase programs pending development of a more long-range plan for maintaining an adequate mobilization base.

Ventilation at Enoco

(Continued from page 25)

instances, since it was always possible to get a reading nearer the face with the use of the tube than by actually testing the gas at the face with the machine running, a 0.1 percent higher reading was always obtained through the tube. Although this method was used for several months, difficulty was experienced in keeping the tubing, lamp holder, and aspirator bulb in good working condition. An improvement over this method was the installation of a methane indicator. The mechanism is set to flash a red light when a mixture of one percent is encountered in the face area. This device gives a continuous check for the presence of methane. It operates accurately and simplifies the gas testing problem. The unit is installed about eight ft back from the cutting head and is located on the operator's side for continuous observation. Because of its height, some difficulty is experienced in mounting the unit, since the coal varies from 50 to 72 in. in height.

When the unit is in service, the operator continues to make occasional examinations with his safety lamp.

Summary

Areas that do not produce much methane can be worked with continuous mining machines very much the same as with conventional equipment, with little or no curtain.

Areas that produce larger quantities of gas require closer supervision, greater volumes of air, better bratticing and more frequent examinations for gas.

After 20 months of experience with continuous mining, the company feels that with a detailed study in the application of booster fans on continuous mining machines the ventilation of face areas can be simplified and kept free of accumulations of methane.

Since the movement of various components of the continuous mining machine in the face area assists in keeping the working place free of methane, it is important that an examination be made for gas after any stoppage of work, before the machine again resumes operations.

The hazard from gas accumulations can also be reduced with the further improvement of continuous automatic methane testing devices.

Article based on paper presented to the National Safety Council, October 7-9, 1955.

Manufacturers Forum

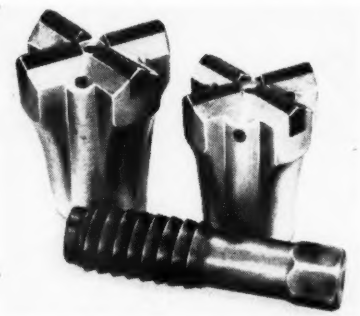
Safety Hat and Cap

A new Safety Hat and Cap with a full-floating headband completely adjustable to head sizes from 6½ to 8 is announced by The Boyer-Campbell Co., 6540 St. Antoine St., Detroit 2, Mich.

Identified as Supergard, it is molded from a flame-retardant, waterproof material in seven different brilliant, permanent colors—red, yellow, blue, white, gray, green, and brown.

600-Series Rok-Bits

The addition of a 600-thread Series to the carbide-insert Rok-Bit line has been announced by Brunner & Lay, Inc., 9300 King St., Franklin Park, Ill. The 3½-, 3-, 2¾- and 2½-in. "X" design bits eliminate the rifling problem, it is said. Where ground conditions are suitable, 2¾- and 3- in. 600-Series Rok-Bits are offered in cross design. These bits fit directly on the G-D extension rods. Each bit has five air holes—center hole, two



other holes on the cutting face and two side holes—to facilitate chip removal and keep the bit from working in its own cuttings, the manufacturer points out.

New Model Geiger Counter

Model 2612L portable geiger counter for uranium prospecting has been announced by the Nuclear Instrument and Chemical Corp., 229 West Erie Street, Chicago 10, Ill. The unit features a sensitive Geiger probe which may be mounted in the handle of the unit or may be removed for surveying crevices, drill holes, cave walls, etc.

Three ranges cover intensities of 0.2, 2 and 20 mr/hr full scale, and a radium source is supplied to permit calibration of the unit at any time. A 0.1 percent uranium ore sample in a sealed container and an identical empty container permit an estimate of the percent of uranium in a discovery. A carrying strap and crystal earphones are also supplied with the instrument.

Brushes for Silicone Insulated Machines

Silicone resins made by Linde Air Products Co., a Division of Union Carbide and Carbon Corp., and used in the manufacture of electrical in-

sulating components for Class H motors and generators, can now be used in totally enclosed dc motors and generators, according to an announcement by the Silicones Department of "Linde." This use is made possible by the development of new carbon brushes now available from National Carbon Co., another Division of UCC.

The new brushes, designated as Grades N-2 and N-6, were designed specifically for electrical machines operating at high temperatures which must be dissipated by radiation. National Carbon reports that the brushes have been successfully applied to a wide range of commutating requirements in totally enclosed, general purpose motors and generators having Class H (silicone) insulation.

Chain Repair Link

Page Engineering Co., Clearing P. O., Chicago 38, Ill., has designed and introduced a unique link for repairing chain right on the job. Called the twin-pin connecting link, the repair unit can also be used as a means of joining the load line to the hitch plate extension, and in larger buckets, as a connection to the trunnion link.

Formed of two interlocking and identical halves, each half is inserted through the ends of the two sections of chain to be joined together. The repair link is then slipped together into its locking position and two oval pins are driven into place. A U-shaped key pin is inserted into the oval pins to hold them securely in place.

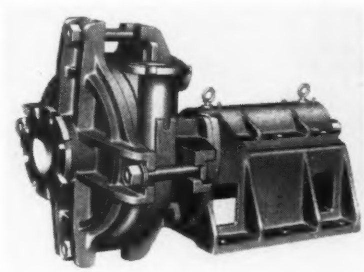
Because of its design and construction, the unit can be used over and over again. Twin-Pin Connecting Links are available in a complete range of sizes from one to three in.

Heavy Duty Pump

A heavy duty suction pump, designated as the Type Q, has been newly introduced to its line of slurry pumps by Morris Machine Works, Baldwinsville, N. Y.

This low speed, continuous duty pump is designed to handle abrasive slurries of cement, sand, coal, solids, chemical sludges, and other products up to the maximum fluid consistency under suction lift or positive head. An all metal pump, the Type Q is available in seven different models from two to six-in. size.

By removing only four bolts, the



Type Q can be opened for most maintenance requirements without disturbing the piping. Interchangeable liners on both sides of the impeller puts the wear on easily replaceable parts; and the rotating element is adjustable to take up for any wear.

External vanes on both sides of the impeller prevent packing between the impeller and casing. The impeller is pressure balanced to prevent recirculation; and is threaded to the shaft and sealed against corrosive action.

V-Belt Manual

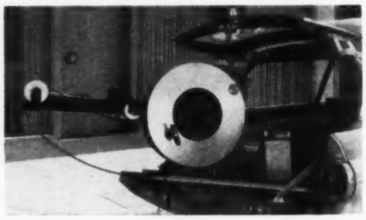
The Multiple V-Belt Drive & Mechanical Power Transmission Association and the Rubber Manufacturers' Association, Inc., have announced the completion and issuance of their 24-page completely revised manual of recommended "Engineering Standards Multiple V-Belt Drives."

The first edition of this standard was issued in 1951. Technological improvements in V-Belts have resulted in greater belt strength with attendent higher horsepower ratings. These have prompted the Technical Committee of both associations to revise their standards.

Copies of the revised manual may be obtained at a cost of $1 each from either the Rubber Manufacturers' Association, Inc., 444 Madison Avenue, New York 22, N. Y., or from the Multiple V-Belt Drive & Mechanical Power Transmission Association, 27 East Monroe Street, Chicago 3, Ill.

Motor Driven Logging Unit

Moran Instrument Corp., 170 East Orange Grove Ave., Pasadena 3, Calif., has introduced a completely motor-driven scintilation counter logging unit designed for the professional prospector and mining engineer. Called the Moran Gamma Logger, the assembly consists of a power driven reel and extending arm, an adjustable pitch metering pulley which drives a footage counter and radiation level graphic



recorder, and a stainless steel probe housing the scintillation counter. The unit can be mounted rigidly on a drill rig or supplied with a portable mounting base for the installation on the bed of a pickup truck, jeep or station wagon.

Thor Expands

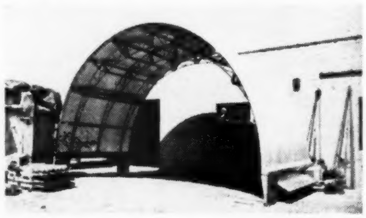
The Thor Power Tool Co., Aurora, Ill., manufacturers of portable air and electric power tools, has announced the acquisition of the assets of the Cincinnati Rubber Manufacturing Co., Cincinnati, Ohio. This company manufactures transmission and conveyor belting, hose, rubber roll covers, packings, gaskets, tubing and associated mechanical rubber products.

Neil C. Hurley, Jr., Thor president, said that under the purchase agreement Thor will pay over $1,600,000 for all of the Cincinnati assets, including inventory, machinery, buildings name and good will.

Cincinnati Rubber Manufacturing Co. has been producing mechanical rubber goods since 1905. No changes in management or operations are contemplated, except that J. F. Joseph, president of the Cincinnati company since 1934, will become chairman of the board, and L. P. Darnall, vice-president and general manager since 1946, will move to the presidency. Both are remaining active in the business.

Rent That Temporary Building

Yard-Stor Shelter Co., 19256 John R, Detroit, Mich., manufacturers of a portable sectional metal storage shelter that tilts, telescopes, and slides apart for easy access, announces its



new line and a rental plan for emergency and temporary uses to be offered through local crane and fork truck rental services.

The company has developed a low-bed trailer for local deliveries which will accommodate two fully assembled shelter sections. The trailer has a crane built into its goose neck, which will unload the shelters and swing them into position.

Shelter sections are built in eight-ft wide prefabricated panels as shipped from the factory. The panels are handled by two men and bolted together to form a shelter section.

To erect, the panels are laid out on location in a logical pattern and with the aid of two small A frame windlasses, which are furnished, the two workmen bolt the panels together, one at a time as they rise to form a fully assembled section.

Longyear Plans Expansion

Part of the E. J. Longyear company's long-range expansion program has been announced by Robert Longyear, president. The program eventually contemplates new major construction of a company headquarters.

The mechanical division, under the direction of Allyn E. Harper has moved from the manufacturing plant at 324 Erie St., SE, Minneapolis, Minn., to 1316 Olson Memorial Highway. The additional space was needed for the growing program of research and development.

The company's purchasing division has moved from the Foshay Tower to the manufacturing plant and it has increased its staff with the addition of Walter Svendsen, former mechanical engineer.

The consulting department, including engineering and geological services, has taken over additional space on the main floor of the Foshay Tower for development of its photo-geological services.

Heavy Duty Vise

The Athol Machine & Foundry Co. of Athol, Mass., has introduced a heavy-duty vise. This vise, weighing 150 lb, has a gripping surface of five by four in. on the face of each jaw with a total depth of approximately six in. Machined into the heat-treated tool steel jaw facing, is a full five in. long pipe grip, which will take a pipe or rod from ⅛ to 6 in. in diameter and give a five-in. long grip on both sides of the pipe or rod to give maximum holding power for freeing fittings or nuts.

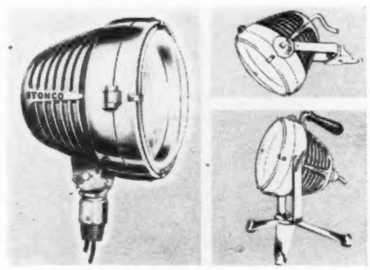
All-Purpose Hose

A new type of all-purpose hose has been announced by Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J. Described as suitable for use with air, oil, water and mild chemicals, the new hose is being marketed under the trade name of Allflex.

Allflex is credited with having eight major advantages, including extremely long life and non-kinking. It is the newest addition to the R/M line of hose, and the first all-purpose hose of mandrel-made, horizontal braided construction.

Floodlight

A new outdoor floodlight producing 115,000 candlepower with only a 500-watt rating has been announced by Stonco Electric Products Co., Kenilworth, N. J. This new unit concentrates its entire light output in an oval-shaped, high-intensity beam.



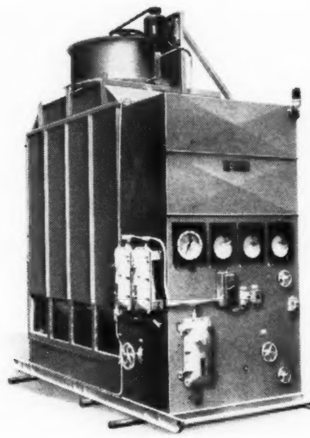
Construction is heavy-duty, noncorrosive, precision cast aluminum throughout with heavy internal and external cast ribs providing twice the normal heat dissipation surface area, and double the cooling rate. Lamp life is stated as 2000 hours. The lamp is cradled in a high-temperature rubber cushion-seal that protects it from shock and abuse, and is sealed rain-tight and water-tight by a heavy-duty cast aluminum hinged cover ring with heat-tempered clear, spred, or colored lenses.

Magnetic Susceptibility Bridge

Geophysical Specialties Co., 4206 Longfellow Ave., Minneapolis 7, Minn., has announced the availability of their MS-1 Magnetic Susceptibility Bridge. This instrument is designed for the rapid, precise measurement of magnetic susceptibilities of rocks and other earth materials for application in aeromagnetic interpretation, ground magnetic interpretation, electromagnetic interpretation, magnetic survey planning, pre-survey anomaly magnitude estimates, and drill core classification.

Ammonia Converter

The pictured new portable ammonia converter is said to be the largest of its kind, engineered and manufactured for Nickel Processing Corp., Nicaro, Cuba. It was built by the J. C. Car-



lile Corp., Denver, Colo., who has developed and is producing a line of portable ammonia converters for the production of aqueous ammonia wherever desired. Additional information can be secured from the J. C. Carlile Corp., 425 Cooper Bldg., Denver 2, Colo.

New Ore Analyzer

A new instrument for determining the amount of uranium and thorium in ores is now being manufactured by Tracerlab, 130 High St., Boston 10, Mass. It is called the Uranium-Thorium Analyzer. The equipment consists of Tracerlab's P20 Scintillation Detector and a geiger tube to be mounted on a shielded well which holds samples of ore bearing uranium and thorium. One detector takes Beta counts while the other reads gamma only. A Tracerlab SC-51R Autoscaler is connected with each detector and counts radiation pulses from the sample. The autoscalers are interconnected so as to stop counting simultaneously either after a predetermined interval chosen on the SC-42 pre-set Timer or after a pre-set count has been obtained on one scaler.

Remote Control TV

Closed circuit TV installations in mines can now be remotely controlled to provide operator safety in hazardous locations, according to Dage Television Division, Thompson Products, Inc., Michigan City, Ind. The company has introduced its "285-A Servo System" which includes a multi-lens TV camera entirely directed by a separate monitor console. By turning an appropriate knob on the console, any function of the TV camera can be achieved. Lens on the camera are changed, focusing is set, and the camera is directed up or down, right or left, all by remote control. A built-in "memory" in the control console also makes it possible to automatically point the camera up to three different "pre-set" directions simply by pushing a button. Dage's "285-A Servo System" and its accessories are described in a detailed brochure available free of charge from Dept. MJ, Dage Television Division, Thompson Products, Inc., Michigan City, Ind.

Rear Dump Trailer

Athey Products Corp., Chicago, announces the new Athey PR 15-Cat DW 15 Rear Dump Trailer. The PR 15 offers a capacity of 15.6 cu yd, speeds up to 31.3 mph, right or left angle turns of 90° and simply designed, 3-stage hydraulic hoists which tilt the body 60°.

The entire loaded unit weighs 84,683 lb with 37 percent of the load on big drive wheels of the Cat 186-hp tractor.

—Announcements—

Appointment of **Herbert K. Kingsbury** as manager of product sales, centrifugal pump section, **Allis-Chalmers Norwood Works**, has been announced by M. L. Murdock, manager of the section.

The appointment of **John S. Newton** as vice-president in charge of engineering, **Goodman Manufacturing Co.**, Chicago, has been announced by W. E. Goodman, president. Newton will be actively engaged in Goodman's mining machinery division but will be available to other divisions for consultation.

V. L. Snow, director of sales for **Euclid Division of General Motors Corp.**, has announced the appointment of **R. E. Keidel** as manager of the Advertising and Sales Promotion Department.

The appointment of **A. F. Pickard** and **J. C. C. Blair, Jr.**, to new positions was recently announced by M. J. Gleason, manager of the contract drilling division of the **E. J. Longyear Co.** Pickard will become assistant manager of Longyear's contract division which carries on drilling operations throughout the world, and Blair will become general field superintendent.

Dorr-Oliver Inc. announces the promotion of **Carlton W. Crumb** to the new post of director of technical data and **Charles M. Comstock** to the position of advertising manager. A veteran of 28 years' service with the present Dorr-Oliver organization, Crumb was formerly sales promotion manager while Comstock served as assistant sales promotion manager.

The announcement of three promotions has been made by the **E. J. Longyear Co. W. Davenport** was advanced from general manager to vice-president and general manager. **V. N. Burnhart,** formerly assistant general manager was made operations manager. **Everett L. Peterson** was named assistant production manager.

Lee T. Ellis has been named manager of **General Electric Company's** Mining and Chemical Systems Sales Unit, System Sales Section.

Southwest Assays, Inc. has opened an assay laboratory at International Airport, San Antonio, Tex. They specialize in five-day returns on uranium ore samples and use same chemical procedures employed by AEC in buying ore.

C. M. Basile, vice-president of sales and manufacturing, **Link-Belt Speeder Corp.**, announces the appointment of **N. V. (Norb) Chehak** as assistant sales manager.

The **Le Roi Division** of the **Westinghouse Air Brake Co.,** Milwaukee, Wis., has appointed **Edward R. Couch** manager of stationary compressor sales.

Deaton Trent, formerly with Hercules Powder Co., has joined **Carboloy Department** of **General Electric Co.,** Detroit, as a representative in the coal mining field. Trent, who makes his headquarters in Harlan, Ky., will service coal-producing areas of Eastern Kentucky, Virginia and Tennessee.

John E. Kaites has joined the sales staff of **The Long Co.** Oak Hill, W. Va., manufacturers of continous-haulage conveyor equipment. Prior to his present position he was resident engineer at the Brule Mine of Ogleby-Norton & Co.

Kaites will headquarter in Johnstown, Pa., and will represent the firm in Pennsylvania and northern West Virginia.

SEE NEXT PAGE FOR CATALOGS—BULLETINS.

CATALOGS & BULLETINS

AIR-LINE LUBRICATORS. *Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.* Form 4169 describes I-R air-line lubricators for use with the smallest hand-held air tools to the largest quarry-type drills. A table is included to help the user select proper size of lubricator for the machine or units to be equipped. Also shown are the physical and chemical requirements of rock drill lubricants.

CONTINUOUS MINER WITH ROOF DRILLS. *Joy Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa.* Bulletin J-404 gives a complete description and specifications for the new Joy ICM-2B Continuous Miner with integral Roof Bolting Drills. A standard 1-CM Miner, the machine is equipped with two RDU-2 Hydraulic Rotary Roof Bolting Drills, one on each side of the machine.

DENVER FILTERS. *Denver Equipment Co., P. O. Box 5268, Denver 17, Colo.* Bulletin FG-B1, describes Denver Disc Filters, Drum Filters and Laboratory Filters used by metallurgical, chemical, coal, cement and other industries. Drawings and specifications of machines and facts about construction and operation are included.

FLUOSOLIDS FOR FINE COAL DRYING. *Dorr-Oliver Inc., Stamford, Conn.* Bulletin No. 7503 describes the operation, advantages, theory and background of this new fluidized coal dryer and cites operating results from the first commercial installation. Also included are photographs and a wash drawing of the unit.

MANGANESE STEEL PAN FEEDER. *Stephens-Adamson Mfg. Co., Aurora, Ill.* Bulletin 255 describes the company's line of "Amsco" Manganese Steel Pan Feeders. Outstanding features of the feeders, typical installations, and detailed specifications are included.

OKONITE GENERAL CATALOG. *The Okonite Co., Passaic, N. J.* Bulletin 1096, Okonite's new general catalog, lists all company trade names, products and their applications. Two selection charts—one by application and environment and the other by cable type—are a practical guide in selecting the best insulated electrical cable for each condition of use. Minimum standard industry specification requirements are also listed for each insulation and covering where applicable.

PERMANENT MAGNETIC PLATES. *The Homer Mfg. Co., Inc., Dept. 62, Lima, Ohio.* Features and applications of Homer Permanent Magnetic Plates are described in bulletin PL-250. Designed for jobs where it is important to remove tramp iron from materials transported by pipes, chutes, belts and other types of conveyors. Bulletin includes application diagrams, performance data and descriptions of all Homer Permanent Magnetic Plates.

STAR JACKS. *Star Jack Co., Inc., River Grove, Ill.* Catalog No. 555 describes the company's services and products. It features specifications, and applications of their pumps, cylinders, jacks, braces and other units.

TEXROPE DRIVE SELECTION. *Allis-Chalmers Mfg. Co., 972 S. 70th St., Milwaukee 1, Wis.* A 74-page booklet designed for the quick and easy selection of constant speed "Texrope" V-belt drives. Information on design features basic drive principles and technical data on sheaves as well as helpful hints for economical, safe and dependable operation of V-belt drives is included. Ask for "TEX-Book" 20P40.

TRONA SODA ASH. *American Potash & Chemical Corp., 3030 West Sixth St., Los Angeles 54, Calif.* This folder has been prepared by American Potash & Chemical for use in the mining and metallurgy industries. Included is information regarding production, various grades of soda ash, distribution and other material pertaining to industrial applications.

Index to Advertisers

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